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OBITUARY NOTICES.

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Joseph Henry Carter, F.R.C.V.S.

MR J. H. CARTER, a well-known member of the veterinary profession, died on 15th May 1930. After a distinguished career as a student at the New Veterinary College, Edinburgh, he became a Member of the Royal College of Veterinary Surgeons in 1882, and a Fellow in 1887. He was elected a Fellow of the Royal Society of Edinburgh in 1905.

For many years Mr Carter carried on a general practice in Burnley, Lancashire, but for the past ten years had been living in retirement at Henley-on-Thames. From 1897 to the time of his death he was an influential and active member of the Council of the Royal College of Veterinary Surgeons, and occupied the Presidential Chair in the year 1913-14.

O. C. B.

**George Goudie Chisholm, M.A., B.Sc., LL.D.**

GEORGE GOUDIE CHISHOLM was born in Edinburgh on 1st May 1850, educated at the High School, which he left as Dux, and at the University, where he took a good place in the Arts classes and graduated M.A. in 1870. With a natural gift for languages he soon added to his knowledge of Latin and Greek a practical acquaintance with French, German, and Italian. He entered on a literary career in the editorial department of W. G. Blackie & Son of Glasgow, where he developed an innate bent towards accurate and methodical work by taking part in the revision of the famous *Imperial Dictionary*. Yielding to the traditional southward urge Chisholm went to London in 1881, and this was his home for more than a quarter of a century. He took the Edinburgh degree of B.Sc. in natural sciences, however, in 1883. Chisholm specialized in Geography, became a University Extension Lecturer in London, and built for himself an enduring reputation in his chosen subject.

In 1908, when Edinburgh established a Lectureship on Geography, the first in any Scottish University, Chisholm was the obvious choice as Lecturer, and in 1921, when the academic grade was sanctioned, he became Reader. After his retirement in 1923 he received the honorary degree of LL.D. from his own University. Freed from routine duties, Dr Chisholm continued to work upon the problems to which he had devoted his life, and death overtook him suddenly and painlessly on 9th February 1930.

Few men of his intellectual power and ceaseless industry have led a life so quiet and uneventful as that which fell to his lot. He worked at home, and both in London and in Edinburgh his wife regulated the routine of the house so as to ensure for him the orderly quiet and seclusion which were his proper environment.

In 1882 Chisholm published his first geographical work, a popular description of the Earth, under the title of *The Two Hemispheres*. It was a sincere and well-proportioned compilation of the best data then available. The Royal Geographical Society, which for fifty years had viewed the encouragement of exploration as its chief purpose, was awakening about that time to a sense of the deplorable neglect of Geography in Great Britain. No university looked on it as worthy of academic recognition; there were few text-books suitable for school use, and such as existed were unscientific in arrangement and inaccurate in their reproduction of the obsolescent sources they drew upon.

When in 1884 Sir John Scott Keltie issued his epoch-marking Report on the State of Geographical Education and threw into vivid contrast the status of Geography in the continental universities and schools and in our own, Chisholm, already prepared for the task, was the first amongst his countrymen to make the advancement of Geography in education the business of his life. He began by producing a series of school geographies for Messrs Longmans which adapted to the conditions of Great Britain and of the different Dominions the principles of the best German *Lehrbücher*. He went on to produce a School Atlas which set a new standard in simplicity, consistency, and the accuracy which depends on truth to scale rather than on minute detail. These pioneer works were a noble contribution to intelligent teaching.

Chisholm's masterpieces, however, were of a much more ambitious character. The first was his massive *Handbook of Commercial Geography*, first published in 1889, when there was hardly yet a public fit to profit by its strong handling of an infinity of authoritative detail. As the years passed, appreciation and demand grew together, and when, two years ago, the eleventh edition appeared, the work had come to be recognised as a classic far beyond the English-speaking world—an Arabic translation published in Cairo attests this.

His other *magnum opus* is the impressive one-volume *Gazetteer of the World* published by Longmans in 1895 and very widely disseminated some years later as *The Times Gazetteer*. It is full and detailed, but so well proportioned in its entries as to remain clear and concise. Its accuracy is amazing, and only the concentration of a disciplined mind could have brought a chaos of isolated facts into such harmonious order.

Chisholm brought the logical powers which made him great as a compiler to bear with equal success on original geographical problems. Good examples are his memoirs on the "Distribution of Towns and Villages in England" and on "Inland Waterways" published in the *Geographical Journal*. He was a regular attendant at the meetings of the British Association, and read many papers to Section E, including the Presidential Address in 1907. As time went on he turned his attention mainly to questions of economic distribution and racial peculiarities. At the end of his life he was engaged on the elaboration of an original system which he termed Economic Ethnography, by means of this he hoped to apply geographical principles to current human problems.

As a teacher Chisholm did not court popularity by cheapening the intellectual price which must be paid for proficiency. He insisted on thoroughness and accuracy at every stage of his university courses, and the



serious student drew from him an inspiration surprising as coming from a man of such quiet and unemotional demeanour. Those who met Dr Chisholm in the University or in the Royal Scottish Geographical Society, of which he was long the Secretary, respected him for his learning, his modesty, and his readiness to help. Apart from the honorary degrees of his own University and the gold medals of American Geographical Societies, he did not receive in his lifetime the honours to which his attainments entitled him; but he permitted no bitterness to shadow his well-balanced outlook on life. He was a generous colleague, ever ready to help a rival as a friend, and the few who penetrated the guard of his meticulous precision recognized him as a man of wide sympathies and liberal culture. His knowledge of Shakespeare was remarkable, and few of his academic acquaintances detected from his conversation the enjoyment he derived from the works of the great Victorian poets.

To whatever test it may be put, the memory of Chisholm rings true as that of a man absolutely sincere, strong in the conscientious fulfilment of every duty, steadfast in purpose, but undisturbed by ambition.

He was elected a Fellow in 1924.

H. R. M.

## George Alexander Gibson, M.A., LL.D.

GEORGE ALEXANDER GIBSON, who passed away on 1st April 1930, was born at Greenlaw, Berwickshire, on 19th April 1858. His father, the late Mr Robert Gibson, was highly respected in the district as a leader in ecclesiastical and political affairs. George Gibson was educated at the local Free Church School, straight from which, in 1874, he proceeded to the University of Glasgow. At Glasgow he won many distinctions in Classics, English Literature, and Philosophy, as well as in Mathematics. His intention to take an Honours degree was unfortunately frustrated by a prolonged illness, which made it impossible for him to take the degree examination within the limit then in force of five years from the date of first matriculation. Nothing daunted, however, in 1882 he presented himself for the Honours Examination and duly gained the Euing Fellowship in Mathematics and Natural Philosophy. In connection with this Fellowship he engaged for some time in research work under Lord Kelvin; but his interests were mathematical rather than physical, and his opportunity came in 1883 when he was asked by Professor William Jack to join the Mathematical Staff. In the following year he became Senior Assistant, and as it was Professor Jack's custom to leave most of the higher work to his assistants, Mr Gibson became, during the following twelve years, an outstanding personality in the teaching and administration of the department. In particular, to him were mainly due the initiation and conduct of numerous courses in Mathematics, pure and applied, which were of great service to the honours students.

In 1895 he was appointed to the Chair of Mathematics in the Glasgow and West of Scotland Technical College. Here he had full opportunity to show his talent as an administrator, not merely in his own department, with, in addition to the day classes, evening classes of 800 students, but in the general affairs of the College. During his period of service there the work of the College was reorganised and the scheme of courses was remodelled. A large share of the success attending these changes was undoubtedly due to him, as was gratefully recognised by the Professors and Governors of the College.

In 1909 Professor Gibson was recalled to the University as successor to Professor Jack. He at once proceeded to reorganise the teaching in the department. Tutorial instruction was provided for all the students, both

ordinary and honours, and the curriculum was widened and extended. After the war the number of students rose to 900, but in spite of all difficulties the high standard of the work was maintained.

Professor Gibson was a great teacher, who loved his work and for whom the interests of his students were paramount. He was also an eager and tireless student, with a remarkably wide and thorough knowledge of mathematical literature. In his early days as a University Assistant he spent an interesting and stimulating summer session at Berlin University, where he attended lectures by Kronecker and Weierstrass. To the Edinburgh Mathematical Society he was indebted for much inspiration and encouragement. This Society was founded on 2nd February 1883, its first president being John S. Mackay. Most of the founders were engaged in school-teaching, but from the beginning Chrystal, Tait, Knott, and other university workers took a large share in its activities. Gibson's first paper was read on 13th March 1885, and from then on he was a constant contributor to the *Proceedings* and a leading figure in the Society. There he formed close friendships, among others, with J. S. Mackay, from whom in all probability he acquired his lifelong interest in the history of mathematics, and with Professor Chrystal, who also exercised a powerful influence on his mathematical outlook and development. Professor Gibson became a recognised authority on certain parts of the history of mathematics, and published numerous papers on the origins of the calculus, on the history of Fourier series, and on the great Scottish mathematicians. He is most widely known, however, as a writer of mathematical text-books. The first of these was his *Elementary Treatise on the Calculus*, first published in 1901, which has become a standard work with a very wide circulation. Later books were *An Elementary Treatise on Graphs* and *An Introduction to the Calculus based on Graphical Methods*, both published in 1904, and *Elements of Analytical Geometry*, written in collaboration with Dr Peter Pinkerton and published in 1910. After his resignation in 1927 he prepared a large and comprehensive treatise on *Advanced Calculus*, which is about to be published. Younger workers found him ever ready to place, in the most generous manner, his wide stores of reading and his long teaching experience at their disposal, and many books, written by members of the Mathematical Department of Glasgow University, have owed much to his encouragement and help.

Professor Gibson was endowed with an enthusiasm for administrative work, and rendered important services to education in Glasgow. He was one of the original members of the Glasgow Provincial Committee for the Training of Teachers; after returning to the University he became a

Governor of the Technical College; for a long period he acted as Chairman of the Governors of the Park School Company; and in the Senate and University Court his sound and forceful counsels carried great weight with his colleagues.

From 1917 to 1920 he held office as Vice-President of the Royal Society of Edinburgh, to which he was elected a Fellow in 1890. The Universities of Edinburgh and Glasgow both conferred on him the degree of LL.D.—the former in 1905, and the latter in 1927. On the occasion of his retirement his friends and students combined to show their respect and admiration by raising a fund for the endowment of lectures on the History of Mathematics, the lectures to be given at intervals in the University of Glasgow and to be known as the George A. Gibson Lectures.

Professor Gibson was a man of wide intellectual interests, an omnivorous reader, and a fluent linguist. His classical attainments stood him in good stead in his researches into mathematical history. He was a keen Liberal, and took an active interest in the affairs of Wellington Church, especially in connection with the Temperance Society, of which he was President.

An indefatigable worker, in spite of frequent attacks of heart trouble he was busy, almost to the end, with the proofs of his last book. He is survived by his widow, two sons, both in the medical profession, and a daughter.

T. M. M.

Sir John R. Findlay, Bart., K.B.E., LL.D.

JOHN RITCHIE FINDLAY was born in Edinburgh on 13th January 1866, the eldest son of the well-known proprietor of *The Scotsman*, to whose enlightened liberality Scotland owes her National Portrait Gallery as well as the building which shelters her National Museum of Antiquities. His first schools were Mr Oliphant's in Charlotte Square and the Collegiate, flourishing institutions then, but both long since defunct. In 1879 he was sent to Harrow, to find among his companions boys destined to make their mark in such diverse ways as Stanley Baldwin and John Galsworthy. Here his predominantly scientific tastes led him naturally to the Modern Side. Nevertheless he was in Dr Butler's Sixth—a clear proof that his other intellectual qualities had not escaped his Headmaster's discerning eye. While he always retained a grateful recollection of what he had learned from Butler, he was still more conscious of a debt to M. G. Glazebrook, who had come to Harrow as an Assistant Master in 1878 and who was afterwards successively High Master of Manchester Grammar School, Headmaster of Clifton, and Canon of Ely.

In 1884 he matriculated at Balliol, where he at once began to specialise in Chemistry. Three years of steady work were rewarded by a comfortable First Class in the Final Science Schools. Such a measure of success would have satisfied most undergraduates. It would probably have satisfied him, had he not unwittingly convinced the College authorities that Oxford had something else to give him. Strachan Davidson, at that time Senior Dean, had been so struck by the capacity displayed in his essays on general subjects that he urged him to prolong his course for two years and read for Honours in *Literae Humaniores*. This was an arduous undertaking for one who had only made a beginning with Greek and had dropped it altogether at Harrow, and in the circumstances the extremely sound Second Class which he obtained in 1887 was really a remarkable achievement. When he went down, Strachan Davidson wrote that, although his handicap had robbed him of his due in the Schools, he was safe for a Double First in life.

Academic distinctions apart, his Oxford experience was a unique preparation for his future career, and he never ceased to look back on it with genuine pleasure. Permeated as it was by the subtly pervasive and unobtrusively powerful influence of Jowett, Balliol society was in

those days nothing if not democratic, while it included an unusually high proportion of men who subsequently became prominent in the Church, in public life, in literature, or in scholarship. Findlay's range of acquaintance was exceptionally wide, not only because he was in residence for five years as against the normal three or four, but also because he pursued in turn two different lines of study. He was no athlete, and he was otherwise too unassuming to make himself a leader in any particular set. But he was universally liked and respected, as was shown by the widespread regret which his death evoked among those of his contemporaries who survived him. They could recall vividly his rather tall, spare figure with its slight stoop, as he moved in and out among them, keenly observant of all that was going on and occasionally giving rein to the quiet humour that seasoned his enjoyment of the human comedy around him.

Immediately on leaving Oxford he entered the office of *The Scotsman*. In order to gain a thorough knowledge of the machine which he was ultimately to control, he served a brief but exacting apprenticeship in each of the departments concerned with the production of a great newspaper. His father's death in 1898 thus found him well equipped for a position of responsibility. For a time he took an active share in the editorial work, particularly when the rigorous climate of Edinburgh drove the then editor, Mr Charles Cooper, abroad for the winter months. He was much interested, but the task proved too exacting. He was expected to play his part in the public life of Edinburgh, and under the growing pressure of day engagements his constitution stubbornly refused to adapt itself to the routine of night duty. Social obligations, too, began to be more insistent in their demands, especially after 1901, when his marriage to Harriet, the eldest daughter of Sir Jonathan Backhouse, laid the foundation of the singularly happy domestic life that was to be his until the end. In 1905 the appointment of a new editor brought him the relief which he desired. Others had already discovered his rare administrative gifts, and, while the welfare of *The Scotsman* always remained his first concern, now that he was comparatively free he responded to the call of public service with an unsparing devotion that was beyond all praise.

As early as 1899 he had succeeded his father on the Board of Manufactures, the old-time body that was responsible to the Government for the administration of the National Galleries and the National Museum of Antiquities. When the Board of Manufactures was superseded in 1907, he was appointed a member of the Board of Trustees which replaced it. He was reappointed at the beginning of each following quinquennium down to 1927 inclusive, and for the last eight years he was Chairman.

The work was peculiarly congenial, for he had real taste and much more than the average layman's knowledge of art and things artistic. This was doubtless one of the reasons which prompted the late Sir James Guthrie to recommend that the Town Council should nominate him to represent the Lord Provost on the Board that was to manage the new College of Art, established in 1907. But the main motive behind the suggestion was an implicit confidence in his business ability and powers of organisation. The confidence was not misplaced. The flourishing condition of the College to-day is largely the fruit of his unremitting labours, extending over no less than twenty-three years. In 1911 and again in 1912 he was Treasurer of the Edinburgh Merchant Company, and in the next two years he held the office of Master, the highest honour that the business community of the City has to bestow. When difficulties emerged as the result of changes in the Scheme for the Superannuation of the Company's teachers and officials, he rose to the occasion and effected the necessary adjustment of conflicting interests quietly and without any ado. Membership of the Burgh Secondary Education Committee gave him further insight into the details of educational administration and lent added weight to his opinion when he was appointed to the Department's Advisory Council in 1924.

This tale of his local activities is far from complete. He was, for instance, a Director of the Royal Asylum at Morningside from 1905 onwards, while he was for twenty-six years on the governing body of the Royal Hospital for Sick Children and for eight years its Chairman. The business affairs of St Giles also claimed their share of his attention. Nor were the wider interests of the nation left without his assistance. As Vice-Chairman of the Ancient Monuments Board he was intimately concerned in the discussions that centred round the Scottish National War Memorial, and he was one of the original members of the Royal Fine Art Commission for Scotland. In 1915, when war-time exigencies made the question of housing accommodation at Rosyth an urgent one, he became Chairman of the Company that was called into being to cope with the situation. A year or two later, when the shortage spread over the whole country like the plague, he accepted the Chairmanship of another Housing Company which had Scotland for its province. Finally, in 1929 he agreed to the request of the Government that he should preside over the deliberations of a Committee which was set up to examine the problem of river pollution; but, before the inquiry had made much progress, the illness that was to prove fatal had laid its hand on him. He died on 13th April 1930.

For several years previously his health had been none too good. Had he allowed that consideration to weigh with him, he would probably have given up much of his public work after 1922, when the death of Mr Law made it imperative that he should take a far more active part in the direction of *The Scotsman*. But he had an extraordinarily high sense of public duty, and he courageously endeavoured to carry the double burden, a burden made all the heavier by his extreme conscientiousness. This conscientiousness, however, contributed materially to his success as an administrator. The discipline of a newspaper office had taught him the value of method. He never willingly missed a meeting at which he felt that he could be helpful, nor did he ever attend one without mastering beforehand all relevant details of the matters to be discussed. Whether he was in the chair, therefore, or merely at the table, his ready command of the facts, his level-headedness, his even temper, and his thorough understanding of human nature made him invaluable. Sparing of speech, he could draft a minute or a resolution with admirable skill, and such was his tact that, even when he was leading the way, he seemed only to be following the suggestions of others.

So crowded a life left scant leisure for recreation or for intellectual pursuits; his very evenings were too often absorbed by preparation for meetings. His summer holiday was invariably spent on his country estate at Aberlour, to which he was warmly attached. In spring he sometimes went abroad, preferably in his later years to Italy, in the art treasures of which he revelled. Paris he had been familiar with from his boyhood, when his father sent him there for a vacation to study French. Subsequently he acquired a reading knowledge of German, and more recently he learned to while away his few idle moments with Italian novels. Behind all this, his well-stocked mind remained faithful to his first love, Science. As he was no mean mathematician, he was able to follow intelligently the astonishing advances which the twentieth century has witnessed in physics, in chemistry, and in astronomy. He was very early elected to the Royal Society of Edinburgh (1898). An invitation to join the Council had to be declined through sheer lack of time. But some years ago he gave the Fellows a glimpse of what he was doing in his own particular corner of the field. Gifted with an uncommonly clever pair of hands, he knew good craftsmanship when he saw it, and this, combined with his fine taste, enabled him to build up gradually the remarkable collection of astrolabes and sun-dials which his widow and son have placed on loan in the Royal Scottish Museum. To him, however, they were not mere curios, like the pieces of old furniture and of old



silver of which he was so excellent a judge. He was deeply read in the literature of the subject, of which he had formed an extensive library; and almost the only publication which he produced under his own name was a paper, read to the Royal Scottish Geographical Society, in which he described how the invention of striking clocks had revolutionised the method of reckoning time. When there was a danger lest the Lewis Evans collection of scientific instruments should be lost to Oxford, his generosity was in no small degree responsible for providing the permanent home that was needed, and he also presented to the University the silver microscope that had belonged to George III. Nearer home it will not be forgotten how he averted a deadlock between the Managers of the Royal Infirmary and the Merchant Company by a timely donation of £10,000.

In 1902 he was made a Deputy Lieutenant for the City of Edinburgh, in 1917 a K.B.E., in 1922 an Honorary Royal Scottish Academician and an LL.D. of the University of Edinburgh, in 1925 a Baronet, and in 1928 Lord-Lieutenant of Banffshire. But these honours left the essential simplicity of his nature entirely unaffected. Writing of him as he was at Harrow and Oxford, Mr O. M. Dalton, formerly of the British Museum, says: "I seem to remember him less for what he did than for what he was—one from quite early days sober in judgment, but keenly alive to the humorous side of things; not demonstrative, but an unselfish and most loyal friend, always considerate and courteous in the widest sense of the term to people in all walks of life." To the very last these qualities attended him, unchanged and unshadowed. *Sit illi terra levis.*

G. M.

**James Alex. George Lamb.**

MR LAMB was born on the 4th March 1869 in the Royal Bank House, Granton, where his father was agent of the bank. Heredity and fate rather than inclination made him a banker; his whole aspirations were towards the intellectual, and his interests were varied. Geology, Mathematics, Music, and Astronomy divided his attention and all his spare time.

He had a good knowledge of harmony and counterpoint, composed songs, both words and music, and at one time got up the work necessary to take a musical degree at a university where attendance at the lectures was not compulsory, but pressure of business prevented him getting away to sit for the examinations.

In science his chief interest lay in Astronomy, and he read everything thereon which came his way. Mirror-grinding also attracted him, and he made an 8-inch mirror for a reflecting telescope.

He served on the Councils of the Edinburgh Geological Society and the Edinburgh Astronomical Association.

Stevenson says, "An aspiration is a joy for ever, a possession as solid as a landed estate, a fortune which we can never exhaust and which gives us year by year a revenue of pleasurable activity. To have many of these is to be spiritually rich." Surely we may apply this to our friend with his many aspirations after the intellectual. He was elected a Fellow of this Society in 1921, and died at Edinburgh on 7th February 1930.

A. G. S.

**Andrew Thomson, M.A., D.Sc., F.I.C.**

ANDREW THOMSON was born in Aberdeenshire in 1850. He graduated in Arts at Edinburgh University in 1878, in Science in 1883, and received the degree of Doctor of Science at the same university in 1886. He was, besides, a Fellow of the Chemical Society of London, a Fellow of the Institute of Chemistry of Great Britain and Ireland, and a Fellow of the Royal Society of Edinburgh (1887).

From the time he entered Moray House Training College, Edinburgh, his life was spent in the service of education. His work as Mathematical and Science Master in Dundee Institution, as Lecturer in Chemistry in University College Dundee, as Mathematical and Science Master in Perth Academy, as Rector in this Academy, all bore the mark of a gifted teacher.

So full of vigour was he at the date of his retiral in 1915 that he willingly bore his share of the burden of that time by giving faithful and successful service in the Science Department of George Watson's Boys' College until 1919. Then he entered upon another strenuous period of activity for four years or so as Joint-Administrator under the Scottish Education Department of the grants issued to ex-service men in Scottish universities. He ceased to work when he ceased to live.

Dr Thomson died on 14th February 1930.

W. A.

**A. A. Scot Skirving, C.M.G., M.B., Ch.B., F.R.C.S.**

WHEN in future years the recent graduates of Edinburgh University meet together and talk about their former Professors and teachers, the name of Mr A. A. Scot Skirving will frequently be mentioned. Many stories will be told of him, and they will all illustrate his individuality of character and his kindly, loving disposition. To few men is it given during their life to acquire the love and respect of so many friends, who were drawn to him by his sterling honesty and worth and the high principles that ruled all his actions in life.

Skirving was an Academy boy, and later as a student and a graduate was an enthusiastic forward in the Academical Football Team. The impetuous enthusiasm that characterised his daily life and practice was equally evident in the playing field, where he was ever an invigorating and enthusiastic leader of many wild rushes down the field.

When he was a graduate of six years' standing and was commencing the practice of surgery in Edinburgh, the South African war broke out, and he went there as a Surgeon, attached to the Imperial Yeomanry Field Hospital. He served in the field, and when proceeding up country with his Unit was captured by De Wet. He was not long a prisoner, however, as Skirving put before his captor the claims of himself and his Unit to be considered non-combatants and the right to be liberated. For his services in South Africa he was mentioned in Despatches and awarded the C.M.G.

On returning again to Edinburgh he resumed work as a Surgeon at Leith Hospital, and was appointed Assistant Surgeon to the Royal Infirmary. At Leith Hospital, where he soon became Senior Surgeon, he did a large amount of surgical work which was always characterised by enthusiasm, accuracy, and thoroughness; but, as was always a feature with him, the cases he described most fully, and the references he made most frequently to his work, were to illustrate such mistakes as he in common with others had made and the errors in judgment he had committed.

When Assistant Surgeon in the Royal Infirmary he was appointed Lecturer in Surgery at the Dental College, and none of the recent graduates of that school will forget the enthusiasm with which he taught his subject and the interest in it he inspired.

On the outbreak of the recent war he was mobilised as an Officer of the Second Scottish Hospital, with which he served at Craigleith. Later he

proceeded to France as a Major in the Royal Army Medical Corps. Those who were his colleagues there know the splendid work he did and how on one occasion, when an Air Raid occurred over the Front Line Hospital to which he was attached and many of the staff were wounded, Skirving, who was in the Operating Theatre, carried on with his work and completed his operations by candlelight and with such assistants as were available.

During the course of his career Mr Skirving carried out research work; but here, again, his enthusiasm was most keenly aroused when he discovered a fault in surgical technique due to inefficient steam sterilisation. His work on this subject was communicated to the Edinburgh Medico-Chirurgical Society, and at the time aroused great interest and led to a careful revision of this essential point in all surgical technique.

Mr Skirving was elected a Fellow of the Royal Society of Edinburgh in 1924.

As a writer he was the author of a revised book on Applied Anatomy and on Operative Surgery. He contributed also various articles to current medical literature. It will, however, neither be as a surgeon, a research student, or an author, but as the colleague and the man that all loved and respected, that the memory of Archibald A. Scot Skirving will be revered. It will be as a chivalrous knight of surgery, the defender of justice, and an honourable gentleman, that his name and memory will be treasured by all who had the privilege to call him friend.

He died on 14th June 1930.

H. W.

J. J. M. S.

**Philip Jacob White, M.B.**

PHILIP JACOB WHITE, though he first saw the light in India, came of good old Aberdeenshire stock. He was born in 1863 at Purandhar in the Bombay Presidency, his father being the Rev. Adam White, a pioneer of mission work in India. He received his education mainly in Edinburgh, first at Fettes College and afterwards at the University. In 1887 he graduated in Medicine, gaining distinction in many of his classes and being a prizeman in Zoology. Soon after graduating he was appointed assistant in the Natural History Department of the University of Edinburgh. This department had been undergoing reorganisation and development, and White's keenness for the subject was especially helpful in carrying on the recently established courses in Practical Zoology. This experience proved of great value to him when in 1889 he was appointed lecturer in Zoology at University College, Bangor, N. Wales. Here he had everything to do, and he threw himself heart and soul into the task of developing his department.

His efforts were so successful that after seven years, in 1896, the lectureship was made into a Professorship of Zoology. He regarded the establishment of a museum as of first-class importance—it may be said it was one of his cherished ideals—and he grudged neither time nor trouble to obtain specimens. His knowledge of comparative anatomy, together with his rare judgment of the value of specimens, stood him in good stead, and in course of time he created a museum which enabled the Natural History students of Bangor to acquire a thorough knowledge of their subject.

His activities were, however, not confined to his own class-room. He did much for the University Extension Movement, lecturing in many of the towns and villages of N. Wales, and in 1895 he instituted a course in Agricultural Zoology—a pioneer step. He was also deeply interested in Marine Zoology. For some thirty years he was a member of the Lancashire and Western Sea Fisheries Committee, and he rendered conspicuous service in connection with the Conway Mussel and Sparling Fishery. In 1890 he was appointed Director of the Biological Station on Puffin Island, founded by Professor Herdman, which had been taken over by the Zoological Department of the University College of N. Wales, and

did useful work in an investigation of the land and sea fauna of the island, and in co-ordinating the results of research of other workers.

He was elected a Fellow of the Royal Society of Edinburgh in 1896. One of his papers, "The Existence of Skeletal Elements between Mandibular and Hyoid Arches in *Hexanchus* and *Læmargus*," was published in the *Transactions of the Society* in 1889, and this paper also appeared in the *Anatomischer Anzeiger* in 1895.

He was a member of the Court of Governors of the National Museum of Wales.

As a man he had a delightful personality. His intense keenness and enthusiasm were contagious, and fired those who came in contact with him, particularly his students, in all of whom he took a personal interest. Many of them will feel his loss irreparable.

He died on 26th December 1929.

J. C. E.

THE RIGHT HON. THE EARL OF BALFOUR, K.G., O.M., LL.D., F.R.S., Chancellor of the University of Edinburgh, and Chancellor of Cambridge University (1919), was born at Whittinghame, East Lothian, on 25th July 1848.

He was elected a Fellow of the Society in 1925, and died on 19th March 1930. (For details of his life and work see *Proc. Roy. Soc. Lond.*, Ser. A, 129, 1930; Ser. B, 107, 1930; *Times*, 20th March 1930; and other notices.)

JOHN BUCKLEY BRADBURY, M.D., F.R.C.P., was born at Saddleworth, in Yorkshire, on 27th February 1841. He was educated at King's College, London, and at Gonville and Caius and Downing Colleges, Cambridge. For thirty-six years he was Downing Professor of Medicine at Cambridge, where he was the oldest resident. He held the appointment of Physician to Addenbrooke's Hospital for fifty years, and was President of the Section of Pharmacology and Therapeutics at the Portsmouth Meeting of the British Medical Association in 1899. Professor Bradbury's works include the following: "Vertigo: its Causes, Importance as a Symptom and Treatment" (1870); and "Some Points connected with Sleep, Sleeplessness, and Hypnotics" (1899).

He was elected a Fellow in 1901, and died on 4th June 1930, aged 89.

WALTER COLQUHOUN, M.A., M.B., C.M. (Glas.), during his career held the following appointments: Lecturer on Midwifery, Govan Cottage Nurses' Training Home; Senior Assistant to the Professor of Physiology, Lecturer on the Physiology of Nerve and Muscle, and Muirhead Demonstrator, University of Glasgow; Medical Officer to Govan School Board. He was the author of papers in the *Journ. Anat. and Physiol.* and in the *Proceedings* of this Society (vol. xxv).

Dr Colquhoun was elected a Fellow in 1904, and died on 2nd April 1930.

DAVID CORRIE, F.C.S., was, prior to his retiral, Works Manager to Nobel's Explosives Co., Ltd., Polmont, Stirlingshire. He was elected a Fellow in 1905, and died on 22nd March 1930.



THE RIGHT HON. THE EARL OF KINTORE, K.T., P.C., G.C.M.G., M.A., LL.D., was born at Edinburgh on 12th August 1852, and educated at Eton, Trinity College, Cambridge, and Aberdeen University. He was elected a Fellow of the Society in 1878, and at the date of his death, 3rd March 1930, was one of its oldest Fellows. (For details of his life and work see *Times*, 4th March 1930, and other notices.)

SIR WILLIAM SYMINGTON McCORMICK, Kt., G.B.E., M.A., LL.D., F.R.S., was born in Dumfries on 29th April 1859. He was educated at the Universities of Glasgow, Göttingen, and Marburg. Prior to his Chairmanship of the University Grants Committee and of the Advisory Council on Scientific and Industrial Research, he was the first Secretary to the Carnegie Trust for the Universities of Scotland, and had held the following appointments: Partner in Wilson & McCormick, Publishers, Glasgow; Assistant to Professor of English, Glasgow University; English Lecturer, Queen Margaret College, Glasgow; Professor of English, University College, Dundee (St Andrews University); Member of Treasury Committees on University Colleges (Great Britain) and on the University of Wales; Member of the Royal Commission on University Teaching in London (1909). His publications include lectures on literature; various papers and essays on Chaucer and Middle-English. He was Joint-Editor of the *Globe Chaucer*.

Sir Wm. McCormick was elected a Fellow in 1903, served on the Council of the Society from 1910-13, and died at Barcelona on 22nd March 1930. (For details of his life and work see *Proc. Roy. Soc. Lond.* (now being prepared) and press notices.)

ROBERT MACKENZIE, M.D. (Edin.), of Napier, Nairn, was born in Edinburgh, and, after being in practice there for some years, retired to Nairn. He was a keen golfer, and for a term was Captain of the Nairn Golf Club. He was elected a Fellow in 1894, and died suddenly at Nairn on 8th September 1930.

FRIDTJOF NANSEN, G.C.V.O., D.Sc., D.C.L., Ph.D., Arctic Explorer and Author, was born near Christiania on 10th October 1861. He was Professor of Oceanography at the University of Christiania (Oslo) from 1908, where previously he had been Professor of Zoology, and was Rector of the University of St Andrews from 1925. From 1906 to 1908 he was the first Norwegian Minister to Great Britain. The Nobel Peace Prize was awarded to him for 1921-22.

Dr Nansen was elected a Foreign Honorary Fellow of the Society in 1897, and died at Lysaker, near Oslo, on 13th May 1930. (For details of his life and work see Notices in *Geographical Journal* (now being prepared) and *Scottish Geographical Magazine*, July 1930, etc.)

SIR GEORGE ARCHDALL O'BRIAN REID, K.B.E., M.B., C.M., was born at Roorkee, India, on 7th April 1860. He was educated privately, and graduated in Medicine and Surgery at the University of Edinburgh. He resided in India and New Zealand, travelled extensively, and was the author of the following volumes: *Present Evolution of Man* (1896); *Alcoholism: a Study in Heredity* (1901); *The Principles of Heredity* (1905); *The Laws of Heredity* (1910); *Prevention of Venereal Disease* (1920); and of numerous papers in scientific periodicals. Sir George was also co-editor of *Bedrock*.

He was elected a Fellow in 1902, and died on 19th November 1929.



## APPENDIX.

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## PROCEEDINGS OF THE STATUTORY GENERAL MEETING

### Beginning the 147th Session, 1929-1930.

At the Statutory General Meeting of the Royal Society of Edinburgh, held in the Society's Rooms, 24 George Street, on Monday, October 28, 1929, at 4.30 P.M.,

Sir Alfred Ewing, K.O.B., F.R.S., President, in the Chair,

the Minutes of the Statutory Meeting held on October 22, 1928, were read, approved, and signed.

The GENERAL SECRETARY submitted the following Report:—

#### SECRETARY'S REPORT, OCTOBER 28, 1929.

By request of the Council an address was delivered on "Quanta in Biology" by Professor HANS PRIZIBRAM of Vienna, on March 4, 1929. 42 papers were read, as compared with 36 in the previous session. The papers were divided among subjects as follows: Mathematics, 8; physics, 4; optics, 1; chemistry, 8; geology, 4; botany, 2; zoology, 7; animal breeding, 7; anatomy, 1. 14 papers have been published or are in course of publication in the *Transactions*, and 26 in the *Proceedings*. 1 paper was read but was not published, and 1 was in the nature of a demonstration. 2 papers were declined for publication, and others received are at present in course of revision.

The Society has lost by death 22 Ordinary Fellows and 5 Honorary Fellows; 4 Ordinary Fellows have resigned. 24 Ordinary Fellows were elected.

It may be mentioned that during the session copies of *Transactions* and *Proceedings* published have been sent to, approximately, 550 Academies, Societies, etc., throughout the world, and that we receive many valuable publications in exchange. £203 has been received by the sale, through Messrs R. Grant & Son, of *Transactions* and *Proceedings*.

Invitations were received and the Society was represented as follows on the occasions mentioned:—

1. Peach and Horne Memorial Committee. The GENERAL SECRETARY.
2. Centenary, Faculty of Medicine, Cairo, December 1928. Sir ROBERT PHILIP.
3. Centenary Celebration of Theodor Billroth, Vienna, April 9, 10, 1929. Letter sent.
4. Centenary of the Zoological Society of London, April 29, 1929. Professor J. C. EWART.
5. Centenary of "Ecole Centrale des Arts et Manufactures," Paris. May 26 to 28, 1929. Letter sent.
6. James Young Memorial at Glenboig, June 14, 1929. Mr H. M. CADELL.
7. International Congress of Geology, August 1929, South Africa. Professor T. J. JEHU.
8. Fifth International Congress of the History of Religions, Lund, August 27 to 29, 1929. Professor JAMES MACKINNON.
9. Memorial Service to Professor W. H. Perkin, Oxford, September 19, 1929. Professor Sir CHARLES SHERRINGTON.
10. Union of the Church of Scotland and the United Free Church of Scotland, October 2, 1929. The GENERAL SECRETARY—Professor R. A. SAMPSON.
11. Centenary of the South African College, Cape Town, October 5, 1929. Sir THOMAS MUIR.
12. Western Reserve University, City of Cleveland, Dedication of Institute of Pathology, October 7, 1929. Letter sent.
13. Centenary of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, October 17, 1929. Dr JAMES RITCHIE.

Dr A. CRICHTON MITCHELL was appointed the Society's representative on the new Governing Body of the Heriot-Watt College, in succession to the late Dr W. A. TAIT.

Professor E. M. WEDDERBURN was appointed to represent the Society on the Advisory Committee, Edinburgh Meteorological Office, in succession to Professor WM. FENNIE, resigned.

The GUNNING VICTORIA JUBILEE PRIZE for the period 1924 to 1928 was presented to Professor E. T. WHITTAKER, F.R.S., on July 1, 1929.

The MACKDOUGALL-BRINSBANK PRIZE for the period 1926 to 1928 was presented to Dr W. O. KERNACK, on July 1, 1929.

The Council received during the session the bequest of the late Dr CHARLES DU RICHE PHELLEN of the sum of £500, to found a BRUCE-PHELLEN LECTURE FUND. A further sum of £100 was received as a donation for purposes of the Library or of publications, at the discretion of the Council.

The thanks of the Society are due to the Carnegie Trust for the Universities of Scotland for grants to authors towards illustrations of papers published by the Society, amounting to £52, 12s. 4d.; to the Royal Society of London Government Publication Grant Committee for £200 towards the printing of the *Transactions and Proceedings*; to Girton College, Cambridge, for £10 towards the cost of Miss S. M. MANTON's paper; to the University of Sydney for £49, 13s. 1d., towards the cost of Professor C. W. STUMP's plates; to the University College of Reading for £50 towards the cost of Dr NELLIE B. EALER's paper; to Miss MARGERY KNIGHT for £20 towards the cost of her plates; to the Somaliland Government for £12, 11s. 1d. towards the cost of Miss LATHAM's plates; and to Drs M'LINTOCK and PHLEMISTER for £7 towards the printing of their plates in colour.

During the Session a considerable amount of new shelving has been added in the Basement, and has made possible certain desirable rearrangement of the books and periodicals throughout the Library.

A rearrangement of the portraits in the possession of the Society upon the two staircases has been made.

Steps have been taken by the Council to calendar and bind the Hume Correspondence (MSS.) in the possession of the Society. Dr J. Y. T. GREIG, Armstrong College, Newcastle-upon-Tyne, has kindly offered to prepare the Calendar, and the volumes of the Correspondence are now in the care of the Librarian, Armstrong College, Newcastle-upon-Tyne, during its preparation. The Treasurer has generously offered to make, in his office, copies of the letters, if this would be of assistance.

An inquiry having been received from a Fellow as to the correct form of abbreviation for indicating Fellowship of the Royal Society of Edinburgh, the Council decided to let it be known, that in its view, the letters F.R.S.E. constitute the correct form.

After reading the annual report, he assured the retiring President that he would carry with him in his retirement something which a man, when his day's work was done, valued more than anything else, and that was their affection.

Sir ALFRED EWING, in his final words from the chair, thanked them for the immense honour done to him in electing him to be president of this Society, and in continuing to re-elect him for the full five years' term of office ending that day. His recollections of this Society, he said, went very far back, to the days when he came up, a raw, young student with a passion for science, about fifty-seven years ago, and began at once to frequent the meetings of the Royal Society, and to watch the play of the great giants of those days, men like Sir William Thomson, afterwards Lord Kelvin, and Tate, and Lister, and Turner, and others who almost equally deserved to be named. There was a habit among some of the younger people of the present day to belittle the Victorians. It was only because they did not know any better. There were giants in those days, and those who as young men were brought under their influence, and were privileged to watch the working of their minds, learnt from them lessons for which they could never afterwards be too grateful.

The work of the president, which he was laying down, had turned out to be lighter than he had expected, thanks to the admirable efficiency of the secretaries and vice-presidents, and especially of his friend, Professor Sampson. They did not need to be told that Professor Sampson possessed some of the family characteristics. He had broad shoulders and a high courage capable of assuming any burden, although he did not go so far usually as to bring down the house.

They were also aware—all scientific workers were painfully aware—of the truth of the commonplace that this was an age of specialisation, so much so that it had been necessary to create many special societies for the purpose of associating workers in particular branches of science. Notwithstanding that, this Society remained comprehensive. It remained catholic. In that respect it resembled its big brother in London, and formed the nucleus, the home, the recognised centre of Scottish scientific activity. Long might it remain to do that! It was essential, and certainly more valuable, that there should be such a centre, which could speak with the voice of all scientific Scotland when occasion required, and could do that without prejudice, but rather with advantage to the more specialised societies which relieved it of some of the detail of its work. Its publications continued as voluminous, important, and dignified as ever. Its house remained the natural home of the science of the North, and its splendid library, which was daily increasing in value, had been made more than ever accessible to students of science whether they belonged to the Society or not. Looking dispassionately, with the eyes of one who was leaving, he thought that the Society was still nobly fulfilling its function as a representative of science in Scotland.

Among the multitude of scientific subjects, said Sir ALFRED EWING, they had probably to distinguish between two groups. There was the group which had always attracted him, and the other group which to some extent he might say had repelled him. By the first he meant the group that made towards what might be called dead matter. By the other he meant the group that related to the phenomenon life. It was a broad distinction. There was no clear-out line between the two, but they had to admit that the scientific men were usually divisible into those who pursued the one or the other of these two functions somewhat exclusively. It was highly proper that in such a Society as this, when a president retired whose study had been of the physics of inanimate things, he should be succeeded by one who had a world-wide reputation for his studies in life. So it was to-day. Sir Edward Sharpey-Schafer had a unique position, and he congratulated the Society upon their choice of him as their new president. He had, he repeated, a world-wide reputation as a scientific investigator and as a pioneer in scientific thought, especially in the exploration of those secret processes which went on within the body which he had made peculiarly his own subject of study. His work on the endocrine glands marked an epoch in the history of physiology, and, he ventured to say, also in the history of medicine.

If they compared the two groups of subjects, he thought they could scarcely refrain from the conclusion that the future rested with Sir Edward and the biologists, and that the physicists were somewhat to-day in the position of a row of extinct volcanoes, though even in the last generation they had been enormously productive. The last thirty-five years had seen a development of physical ideas on a scale really unprecedented in the history of science. They had seen the birth of the electron, the X-rays, and the quantum theory of relativity, to name only a few of the many great results. On the applied side, in which he had been as an engineer especially interested, they had had the development of the internal combustion engine with its consequence in the conquest of the air, and they had had the application of the electric wave to wireless telegraphy. Taking these two things together, they had had a development of means of transport and communication such as they had never known before. It was perhaps only the tendency of an elderly pessimist, but he could not help asking himself what was left to be done on

these lines. There was no doubt a vast amount of detail still to be filled in. There would be improvement in small points, greater safety in flying, and greater secrecy perhaps in wireless communications; but the work was done to a very great extent, and it was not easy to see what region was now unexplored on that physical side. It was true that some of the explorers were continuing their intellectual flights into spheres where the ordinary worker could not even begin to follow. They were using language which he was quite unable to understand, and they were apparently satisfying themselves—or, at all events, that was all one could get out of them—of the expression of the parts of the atom in the form of mathematical equations. It was extremely difficult for anyone to form what might be called a physical conception or mental picture of any kind which had any relation to other ideas in attempting to follow this recent work. It was not easy to believe that it could have the kind of fruitful effects which had so distinguished the period he had named with regard to other discoveries.

Turning from that to the biological side, Sir ALFRED EWING pointed to an immense continent of knowledge the exploration of which had only just been begun. There seemed to be unlimited possibilities of discovery in regard to the province of life. It was a subject of which they could scarcely be said to have touched more than the fringe, and so they might look forward rather confidently to very great and fundamental scientific discoveries in the biological group of sciences, discoveries which would not only be of immense philosophic interest, but which would also clearly have the possibility of application for the benefit of man.

It was a dangerous thing to enter upon any words of prophecy. Still, such as these remarks were, he ventured to put them before them, and they seemed appropriate in this sense, that the Society was now going to be placed under the leadership of a very great apostle of biology, a leadership which could not fail to have fruitful results.

There was, he said, a still more obscure region where there ought to be tremendous possibilities of discovery yet unmade of man, the whole region which connected body with mind. Even if they had succeeded in solving the problem of life, they would still be left with this further question of relation between the conscious will and the effect it apparently produced upon matter. How was the will able, like the pointman on a railway, to deflect the course of subsequent events without prejudice either to the conservation of energy, the conservation of matter, or any of the familiar truths of physical science? There was a field of inquiry which opened up limitless possibilities. Perhaps they would never be able to answer these questions, but in the meantime there was a continent of knowledge which was inviting the scientific worker.

"Science will always, I think," said Sir ALFRED in conclusion, "continue to lure votaries as she has done in the past. She will offer them the reward of pains and efforts and failures, and occasionally the reward of success; but whether they have that or not, they will at least have the satisfaction of knowing that it is better to travel than to arrive; they will always have the joy of effort."

The accounts for the Session were presented.

The PRESIDENT nominated as Scrutineers of the Ballot, Professor WILLIAM WILSON and Professor SYDNEY SMITH.

The Ballot for the Election of Council and Office-Bearers was then taken.

Professor J. Y. SIMPSON moved the adoption of the Reports, and the reappointment of Messrs LINDSAY, JAMIESON & HALDANE, C.A., as auditors for the ensuing Session. These motions were seconded by Mr H. M. CADELL, and approved.

The Scrutineers reported that the Ballot Papers were in order, and the PRESIDENT declared that the following Office-Bearers and Members of Council had been duly elected:—

Professor Sir E. A. SHARPEY-SCHAFER, M.D., D.Sc., LL.D., F.R.S., President.	
Em. Professor W. C. M'INTOSH, M.D., D.Sc., LL.D., F.R.S.	
Sir ROBERT W. PHILIP, M.A., M.D., LL.D.	
Professor J. GRAHAM KERR, M.A., F.R.S., F.I.S.	} Vice-Presidents.
Professor W. WRIGHT SMITH, M.A.	
Professor F. G. BAILY, M.A., M.Inst.E.E.	
Professor T. J. JEHU, M.A., M.D., F.G.S.	
Professor R. A. SAMPSON, M.A., D.Sc., LL.D., F.R.S., General Secretary.	
Professor C. G. DARWIN, M.A., F.R.S.	} Secretaries to Ordinary Meetings.
JAMES RITCHIE, M.A., D.Sc.	
JAMES WATT, W.S., F.F.A., LL.D., Treasurer.	
Professor D'ARCY W. THOMPSON, C.B., D.Litt., F.R.S., Curator of Library and Museum.	

#### ORDINARY MEMBERS OF COUNCIL.

Professor J. H. ASHWORTH, D.Sc., F.R.S.	Professor H. W. TURNBULL, M.A.
Professor E. TAYLOR JONES, D.Sc.	Sir JAMES WALKER, Kt., D.Sc., LL.D., F.R.S.
J. B. CLARK, M.A., LL.D., J.P.	JAMES DREYER, M.A., B.Sc., D.Phil.
Professor F. A. E. CREW, M.D., Ch.B., D.Sc., Ph.D.	A. H. R. GOLDIE, M.A., B.A.
Professor J. MONTAGU F. DRUMMOND, M.A.	ROBERT ALEX. HOUSTON, M.A., Ph.D., D.Sc.
DAVID ALAN STEVENSON, B.Sc., M.Inst.C.E.	The Hon. LORD SANDS, Kt., K.C., LL.D., D.D.

The new PRESIDENT, Professor Sir E. A. SHARPEY-SCHAFER, F.R.S., then took the chair and before closing the meeting, thanked the Scrutineers for their services.



## PROCEEDINGS OF THE ORDINARY MEETINGS, Session 1929-1930.

### FIRST ORDINARY MEETING.

*Monday, November 4, 1929.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

Dr T. SOUTHWELL and Dr B. P. WIESNER signed the Roll, and were formally admitted as Fellows.

The following Communications were submitted :—

1. Notes on the Development of *Callichthys littoralis*. By Miss FRANCES M. BALLANTYNE, M.A. Communicated by Professor J. GRAHAM KERR, F.R.S. *Trans.*, vol. 56, pp. 437-466.
2. Some Observations on the Thymus Gland in the Fowl. By A. W. GREENWOOD, M.Sc., Ph.D. *Proc.*, vol. 50, pp. 26-37.
3. On the Mechanism of the Diphasic Sex Cycle. By B. P. WIESNER, Ph.D.
4. On the Presence of a Kyogenic Substance in the Mouse Placenta. By L. MIRSKAIA, Ph.D. Communicated by Professor F. A. E. CREW. *Proc.*, vol. 50, pp. 104-112.
5. Variations of the Rest Metabolism of the Rat in relation to the Sex Cycle. By A. C. FRASER, Ph.D., and B. P. WIESNER, Ph.D. *Proc.*, vol. 50, pp. 1-7. (Read by title.)
6. Further Invariant Theory of Two Quadratics in  $n$  Variables. By Professor H. W. TURNBULL, M.A., and JOHN WILLIAMSON, M.A., Ph.D. *Proc.*, vol. 50, pp. 8-25. (Read by title.)

### SECOND ORDINARY MEETING.

*Monday, December 2, 1929.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

Dr K. FRASER signed the Roll, and was formally admitted a Fellow.

By request of the Council, Professor V. G. CHILDE, F.R.A.I., F.S.A., delivered an Address on "The Early Colonisation of Northern Scotland as Illustrated by the Recent Discoveries in Orkney." *Proc.*, vol. 50, pp. 51-78.

### THIRD ORDINARY MEETING.

*Monday, January 13, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

The following Communications were submitted :—

1. A Case of Intersexuality in *Bos indicus*, with a Theory of the Significance of the Genetic Male Intersex. By D. R. R. BURT, B.Sc. Communicated by Professor F. A. E. CREW. *Proc.*, vol. 50, pp. 118-129.
2. The Occurrence of Cell Division in the Endodermis. By GEORGE BOND, B.Sc. Communicated by Professor MONTAGU DRUMMOND, M.A. *Proc.*, vol. 50, pp. 38-50.
3. Chromosome Linkage and Syndesis in *Gnathosia*. By DAVID G. CATCHESIDE, B.Sc. Communicated by Professor MONTAGU DRUMMOND, M.A. *Trans.*, vol. 56, pp. 467-464.

FOURTH ORDINARY MEETING.

*Monday, February 3, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

The following Communications were submitted:—

1. On Changes of Rock Temperatures and Irregularities of the Earth's Rotation. By R. W. WRIGLEY, M.A. *Proc.*, vol. 50, pp. 153-165.
2. The Morphology of *Trichomanes aphleboides*, Christ, with Special Reference to the Aphlebioid Leaves. By S. WILLIAMS, M.Sc., Ph.D. *Proc.*, vol. 50, pp. 142-152.
3. On the Presence of a Kyogenic Substance in the Corpus Luteum of the Cow. By J. S. PATEL, B.Sc., M.Sc. Communicated by Professor F. A. E. CREW.
4. Genetic Studies on the A and B Races of *Drosophila obscura*. By PIUS KOLLER, O.S.B. Communicated by Professor F. A. E. CREW.
5. Maturity in the Mouse. By Professor F. A. E. CREW and Miss L. MIRSKAIA, Ph.D. *Proc.*, vol. 50, pp. 179-186.
6. Report of the Jasper Park Lakes Investigations, 1925-26. The Mollusca of Jasper Park. By Mr ALAN MOZLEY. Communicated by Dr C. H. O'DONOGHUE. (Read by title.) *Trans.*, vol. 56, pp. 647-669.

FIFTH ORDINARY MEETING.

*Monday, February 17, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

By request of the Council, Professor CARL STØRMER, Kongelige Frederiks Universitet, Oslo, delivered an address entitled "Do the Wireless Echoes of Long Delay come from Space Outside the Moon's Orbit?" *Proc.*, vol. 50, pp. 187-199.

SIXTH ORDINARY MEETING.

*Monday, March 3, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

The Society proceeded to the election of Fellows, and the following were elected, Sir T. HUDSON BEARE and Mr H. M. CADELL acting as Scrutineers:—

WILLIAM ANNAN, DAVID RAITT ROBERTSON BURT, JOHN CUNNINGHAM, LEWIS MERSON DAVIES, ALEX. BRENEZER M'LEAN GEDDES, DOUGLAS GUTHRIE, Sir THOMAS HENRY HOLLAND, DAVID JACK, SAMUEL GRIFFITH JONES, PERCY SAMUEL LELEAN, JAMES WOTHERSPOON LOW, AND CORRIE M'CANDLISH, WM. CHRISTOPHER MILLER, JOHN MILLER WOODBURN MORISON, JAMES MORTON, WILLIAM OLIVER, GEORGE FRANCIS O'RIORDAN, ALLAN WATT RITCHIE, DAVID RUSSELL, FREDERICK WHALLEY SANSOME, ERNEST CLAUD SHANKLAND, ROBERT HENRY SLATER, JOHN WILLIAM STRUTHERS, CLAUDE WITHERINGTON STUMP, JOHN DONALD SUTHERLAND, CECIL INNES BOTHWELL VOGEL, ADAM CAIGNS WHITE.

The following Communications were submitted:—

1. River Flows of the Ness Basin. By W. N. M'CLEAN, M.A., A.M.I.C.E. Communicated by Professor R. A. SAMPSON, F.R.S.
2. Metamorphism in Relation to Structure in the Scottish Highlands. By GERTRUDE LILIAN ELLES, M.B.E., D.Sc., and CECIL EDGAR TILLEY, Ph.D., B.Sc. Communicated by Professor E. B. BAILLY, M.C., B.A. *Trans.*, vol. 56, pp. 621-646.

## SEVENTH ORDINARY MEETING.

*Monday, March 17, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

Professor WM. ANNAN, Dr J. CUNNINGHAM, Lt.-Col. L. M. DAVIES, Dr A. E. M. GEDDES, Dr D. GUTHRIE, Professor P. LELEAN, Dr JAMES MORTON, Professor WM. OLIVER, and Mr A. W. RITCHIE, signed the Roll, and were formally admitted as Fellows.

Professor JERU was asked to preside in place of the President.

The following Communications were submitted:—

1. The Genus *Dictyoconus* and its Allies: A Review of the Group, together with a Description of Three New Species from the Lower Eocene Beds of Northern Baluchistan. By Lt.-Col. L. M. DAVIES, R.A., F.G.S. *Trans.*, vol. 56, pp. 485-505.
2. The Doleritic Isles of the North Minch. By FREDERICK WALKER, Ph.D. *Trans.*, vol. 56.
3. The Carboniferous Sediments of Kintyre. By W. J. MCCALLIEN, B.Sc., and Mr R. B. ANDERSON. Communicated by Dr G. W. TYRELL. *Trans.*, vol. 56, pp. 599-619.
4. A Contribution to the Geology of North-eastern Antrim; being an Introduction to the Correlation of the Dalradian Rocks of Scotland and Ireland. By W. J. MCCALLIEN, B.Sc.
5. On a New Method of Measurement of Minute Alternating Currents. By D. F. MARTYN, Ph.D., A.R.C.Sc. Communicated by Professor E. TAVLOR JONES. *Proc.*, vol. 50, pp. 166-174. (Read by title.)

## EIGHTH ORDINARY MEETING.

*Monday, May 5, 1930.*

Professor J. Graham Kerr, F.R.S., Vice-President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

Dr J. M. W. MORISON, Principal G. F. O'RIORDAN, and Dr R. H. SLATER, signed the Roll, and were formally admitted as Fellows.

The Chairman announced the award of the KEITH PRIZE (1927-29) to Dr CHRISTINA C. MILLER, for her papers on the Slow Oxidation of Phosphorus, of the NEILL PRIZE (1927-1929) to Professor E. B. BAILEY, F.R.S., for his contributions on the Geology of Scotland, and of the JAMES SCOTT PRIZE to Professor NIELS BOHR.

The following Communications were submitted:—

1. On Some Curious Fossils from the Downtonian and Lower Old Red Sandstone of Scotland. By R. CROOKALL, Ph.D. Communicated by Dr T. M. FINLAY. *Proc.*, vol. 50, pp. 175-178.
2. Studies on the Scottish Marine Fauna.—Additional Observations on the Fauna of the Sandy and Muddy Areas of the Tidal Zone. By A. C. STEPHEN, B.Sc. *Trans.*, vol. 56, pp. 521-535.
3. The Feeding Mechanism, Formation of the Tube and Physiology of Digestion in *Sabella pavonina*. By Miss E. A. T. NICOL, B.A., Ph.D. Communicated by Professor J. H. ASHWORTH, F.R.S. *Trans.*, vol. 56, pp. 537-548.
4. The Distribution of Gene Ratios for Rare Mutations. By R. A. FISHER, D.Sc., F.R.S. Communicated by Professor GODFREY H. THOMSON. *Proc.*, vol. 50, pp. 204-219.
5. The General Form of the Orthogonal Polynomials for Simple Series with Proofs of their Simple Properties. By Miss F. E. ALLAN, M.A. Communicated by Professor E. T. WHITTAKER, F.R.S. *Proc.*, vol. 50, pp. 310-320. (Read by title.)

## NINTH ORDINARY MEETING.

*Monday, May 19, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

After certain introductory remarks by the President, by request of the Council, Professor GEORG WIEGNER, Department of Agricultural Chemistry, Eidgenössische Technische Hochschule, Zurich, delivered an Address entitled "Base Exchange."

Dr ALEXANDER LAUDER moved a vote of thanks to Professor WIEGNER for his Address.

## TENTH ORDINARY MEETING.

*Monday, May 26, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

Dr D. JACK, Dr D. N. M'ARTHUR, Dr C. VOGEL signed the Roll, and were formally admitted as Fellows.

Professor NIELS BOHR signed the Roll as a Foreign Honorary Fellow.

The President made a short Address in presenting to Professor NIELS BOHR the SCOTT PRIZE :—

The great transformation which has been undergone by physical theory during the last thirty years is due to many philosophers. It was started by PLANCK, and is, perhaps, not yet quite concluded, but it is no rash prophecy to say that, whatever new developments may come, the name of BOHR will stand as chief among the contributors to the theory. At the time when he began his speculations it was not yet fully recognised that the existence of the quantum implied a complete revolution in the foundations of dynamics. BOHR, more clearly than any other, conceived that no compromise was possible, and since there were then no sufficient data to make a new foundation he began the synthesis of the mutually contradictory theories by deliberately borrowing from both. This was a task which would have shocked the logician, and would have led most men into glaring error, but all through his speculations he contrived to keep an even balance of sound judgment. The result was the theory of Spectra, which starting from his theory of the hydrogen spectrum, and guided by his Correspondence Principle, in the course of twelve years reduced to complete order an intricate mass of detail which before had appeared as confused as any that are considered even by the biologist. Guided by the same principle he was led to speculate on the structure of the atoms, and explained in outline the form of the periodic table of the elements. A by-product of this work was the discovery of the missing element Hafnium by his colleague HEVESEY. This element had before been supposed to be a "rare earth," but from his theory of the periodic table, BOHR predicted that it should resemble Zirconium, and it was immediately found in zirconium minerals.

The expected revolution in the foundations of physics was accomplished by a young man working in Bohr's Institute at Copenhagen, guided by the inspiration and judgment of his chief. Indeed, though Bohr's name is not attached as author to much of the enormous literature of the new subject, it would be hard to find a branch of it in which his criticism has not encouraged the over-cautious and restrained the injudiciously rash. We confidently anticipate that a man who has accomplished so much between the ages of 30 and 45 will double that amount before he has achieved the human span, and in token of his past work we have much pleasure in presenting the James Scott Prize to Professor NIELS BOHR.

In terms of the award of the JAMES SCOTT PRIZE and by request of the Council, Professor NIELS BOHR, Universitets Institut for Teoretisk Fysik, Copenhagen, then delivered an Address entitled "Philosophical Aspects of Atomic Theory." *Proc.*

Professor R. A. SAMPSON proposed a vote of thanks to Professor BOHR.

## ELEVENTH ORDINARY MEETING.

*Monday, June 2, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

The President announced :—

1. The award of the BRUCE MEMORIAL PRIZE (1930), by the Joint Committee of Award, to Mr N. A. MACKINTOSH, A.R.C.S., M.Sc., for his researches into the biology of whales in the waters of the Falkland Islands Dependencies.

2. The nomination of the following gentlemen by the Council for election to the Society on July 7 as British and Foreign Honorary Fellows :—

*British Honorary Fellows.*—Sir ARTHUR STANLEY EDDINGTON, F.R.S., Plumian Professor of Astronomy and Experimental Philosophy in the University of Cambridge. Sir WILLIAM BATE HARDY, F.R.S., Director of Food Investigation, Department of Scientific and Industrial Research. Sir ARTHUR KEITH, F.R.S., Hunterian Professor and Conservator of the Museum of the Royal College of Surgeons, London. JOHN EDWARD MARR, F.R.S., Woodwardian Professor of Geology, St John's College, Cambridge. ROBERT ROBINSON, F.R.S., Waynflete Professor of Chemistry in the University of Oxford. DUKINFIELD HENRY SCOTT, F.R.S., lately Honorary Keeper of the Jodrell Laboratory, Royal Botanic Gardens, Kew.

*Foreign Honorary Fellows.*—VILHELM FREIMANN KOREN BJERKNES, Professor of Physics, Geophysical Institute, Bergen. WALTER BRADFORD CANNON, Professor of Physiology, Harvard University, Cambridge, U.S.A. MAURICE CAULLEY, Professor of Zoology in the University of Paris. GIULIO FANO, Professor of Physiology in the Royal University of Rome. ERIK HELGÖ OSWALD STENHÖ, Professor, Royal Natural History Museum, Stockholm.

3. The Delivery by Dr G. C. SIMPSON, F.R.S., of an Address on "The Climate during the Pleistocene Period," at the meeting of the Society to be held on June 16, at 4.30 p.m.

Dr A. C. WHITE and Mr O. F. T. ROBERTS signed the Roll, and were formally admitted as Fellows.

The following Communications were submitted :—

1. On Radiative Diffusion in the Atmosphere. By O. F. T. ROBERTS, M.C., M.A. *Proc.*, vol. 50, pp. 225-242.
2. A Simple Spectrum Comparator. By DAVID JACK, M.A., B.Sc., Ph.D. *Proc.*, vol. 50, pp. 200-203.
3. Certain Quinoline and Benzacridine Derivatives yielding Coloured Adsorption Compounds with Iodine. By W. O. KERMAK, M.A., D.Sc.; R. H. SLATER, B.Sc., Ph.D.; and W. T. SPRAGG. *Proc.*, vol. 50, pp. 243-261.
4. A Study of Apothecial Development in the Leaf-Spot Disease of Red Clover. By S. G. JONES, D.Sc. *Trans.*, vol. 56, pp. 507-519. (Read by title.)
5. Tables of the Elliptic Cylinder Functions. By Professor E. L. INCE, M.A., D.Sc. (Read by title.)

#### TWELFTH ORDINARY MEETING.

*Monday, June 16, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

By request of the Council, Dr G. C. SIMPSON, C.B., D.Sc., LL.D., F.R.S., Director of the Meteorological Office, delivered an Address entitled "The Climate during the Pleistocene Period." *Proc.*, vol. 50, pp. 262-296.

#### THIRTEENTH AND LAST ORDINARY MEETING.

*Monday, July 7, 1930.*

Professor Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair.

The Minutes of the last Ordinary Meeting were held as read.

A ballot was taken for the election of British Honorary Fellows and Foreign Honorary Fellows, and on the report of the Scrutineers, Sir LESLIE MACKENZIE and Mr MURRAY MACGREGOR, the following were declared to be duly elected :—

*British Honorary Fellows.*—Sir ARTHUR STANLEY EDDINGTON, F.R.S. Sir WILLIAM BATE HARDY, F.R.S. Sir ARTHUR KEITH, F.R.S. JOHN EDWARD MARR, F.R.S. ROBERT ROBINSON, F.R.S. DUKINFIELD HENRY SCOTT, F.R.S.

*Foreign Honorary Fellows.*—VILHELM FRIMANN KORN BIERKKNES, Bergen. WALTER BRADFORD CANNON, Harvard. MAURICE CAULLERY, Paris. GIULIO FANO, Rome. ERIK HELGE OSWALD STENSIÖ, Stockholm.

Sir THOMAS H. HOLLAND signed the Roll, and was formally admitted as a Fellow.

The KEITH, NEILL, and BRUCE Prizes were presented as follows:—

The KEITH PRIZE for the period 1927-1929, to Dr CHRISTINA C. MILLER, B.Sc.

The NEILL PRIZE for the period 1927-1929, to Professor E. B. BAILEY, M.C., B.A., F.R.S. Presentation (*in absentia*) of the BRUCE PRIZE (1930) to N. A. MACKINTOSH, M.Sc., A.R.C.S. On presenting the prizes the President read the following statements:—

#### KEITH PRIZE, 1927-1929, to Dr CHRISTINA C. MILLER.

Miss MILLER is one of the very few chemists who at this time cultivate inorganic chemistry. The problem of the slow luminescent oxidation of phosphorus at which she has worked for some years is one of the most puzzling in chemical science and has been attacked without much success by many chemists of distinction. The doyen of inorganic chemistry in this country has said of her work: "I regard Miss MILLER's contribution to our knowledge of the subject as the most important advance made in the last twenty years. I have been struck with the way her idea developed logically from point to point until the climax, the discovery that phosphorus trioxide could not be the source of the glow of phosphorus, was reached."

#### NEILL PRIZE, 1927-1929, to Professor E. B. BAILEY, F.R.S.

Professor E. B. BAILEY has made many and notable contributions to the Geology of Scotland. The greater part of his work has been done as a member of the Geological Survey. Under the inspiration of Dr PRACH he devoted himself to the problems of tectonics, which are so puzzling in the elucidation of

the structure of the Highlands of Scotland. In the official publications of the Survey and in many memoirs and papers contributed to our own *Transactions* and to the transactions and journals of various other scientific societies he has enunciated the theory of large-scale recumbent folds and slides in explanation of the structure of the Southern Highlands. These brilliant communications have provided a great stimulus to the study of this difficult region, and, though his views are not accepted in their entirety by all geologists, there can be no doubt that for part of the region at any rate they provide the right solution.

Another field in which he has distinguished himself is that of the investigation of the igneous rocks of old Red Sandstone, Carboniferous, and Tertiary times in Scotland. His work in association with Dr CLOUGH and others on the Cauldron subsidence of Glencoe and the associated igneous phenomena and on the very complicated volcanic history of Mull and the smaller Isles may be specially mentioned.

In still another field, namely, that of glacial geology, in association with Professor KENDALL, he traced out the interesting phenomena which marked the retirement of the great ice-sheet in East Lothian.

These are the most conspicuous but by no means the only contributions which he has made to the geology of this country.

Professor BAILEY'S work is characterised by versatility and suggestiveness. He is inspiring and adventurous, and is regarded at home and abroad as one of our most brilliant workers in the field.

It is worthy of mention that in the Great War he proved himself to be a gallant soldier and was awarded the Military Cross. Though handicapped by severe wounds inflicted on him in that struggle he has since the war pursued his geological work with undiminished vigour.

He is well worthy of the prize which the Society awards him.

#### BRUCE PRIZE, 1928-1930, to Mr N. A. MACKINTOSH, A.R.C.S., M.Sc.

The BRUCE PRIZE has been awarded by the Joint Committee consisting of representatives from the Royal Society of Edinburgh, the Royal Physical Society, and the Royal Scottish Geographical Society, to Mr N. A. MACKINTOSH, A.R.C.S., M.Sc. It is a condition of the award of this prize, which was founded in 1923 to commemorate the work of Dr W. S. BRUCE in polar regions, that the recipient should be at the outset of his career as an investigator and that he must have made some notable contribution to knowledge as the outcome of a personal visit to polar regions. Mr MACKINTOSH, who is thirty years of age, was in charge of the Marine Biological Station at South Georgia from its opening in January 1925 until May 1927. He has also had experience at whaling stations in South Africa and in the Shetlands. In November 1929 he was appointed Chief Scientific Officer under Dr S. KEMP in "Discovery II," which is continuing the investigations into the biology of whales in the waters of the Falkland Islands Dependencies. Mr MACKINTOSH is the author with Mr J. F. WHEELER of a monograph on "Southern Blue and Fin Whales," in *Discovery Reports*, vol. I.

The following Communications were submitted:—

1. The Metabolism of the Heart. By Professor A. J. CLARK, B.A., M.D., C. P. STEWART, M.Sc., Ph.D., and R. GADDIE, B.Sc. *Proc.*, vol. 50, pp. 297-303.
2. The Definite Integrals of Interpolation Theory. By E. T. COPSON, M.A., D.Sc. *Proc.*, vol. 50, pp. 220-224. (Read by title.)
3. On Some Persymmetric Determinants. By J. GERONIMUS (Ukraina, Kharkow). Communicated by Sir THOMAS MUIR, C.M.G., F.R.S. *Proc.*, vol. 50, pp. 304-309. (Read by title.)

## PROCEEDINGS OF THE STATUTORY GENERAL MEETING

### Ending the 147th Session, 1929-1930.

At the Statutory General Meeting of the Royal Society of Edinburgh, held in the Society's Rooms, 24 George Street, on Monday, October 27, 1930, at 4.30 p.m.,

Sir E. A. Sharpey-Schafer, F.R.S., President, in the Chair,

the Minutes of the Statutory Meeting held on October 28, 1929, were read, approved, and signed.

The GENERAL SECRETARY submitted the following Report:—

#### SECRETARY'S REPORT, OCTOBER 27, 1930.

By request of the Council addresses were delivered on "The Early Colonisation of Northern Scotland as Illustrated by the Recent Discoveries in Orkney," by Professor V. G. CHILDE, on December 2, 1929; "Do the Wireless Echoes of Long Delay come from Space Outside the Moon's Orbit?" by Professor CARL STÖRMER, on February 17, 1930; "Base Exchange," by Professor GEORG WIEGNER, on May 16, 1930; "Philosophical Aspects of Atomic Theory," by Professor NIELS BOHR, on May 26, 1930; and on "Climate during the Pleistocene Period," by Dr G. C. SIMPSON, on June 16, 1930. Professor CHILDE's, Professor STÖRMER's, and Dr SIMPSON's addresses have been published in the *Proceedings* of this session, and it is expected that Professor BOHR's address will be published at an early date. 35 papers were read as compared with 42 in the previous session. The papers were divided among subjects as follows: Mathematics, 6; physics, 4; chemistry, 1; geology, 4; palaeontology, 2; botany, 4; zoology, 4; animal genetics, 8; physiology, 1; engineering, 1. 10 papers have been published in the *Transactions* and 22 in the *Proceedings*. 2 papers were read but have not yet been submitted in final form, 6 have been declined for publication, and 1 is at present under revision.

The Society has lost by death 16 Ordinary Fellows and 1 Honorary Fellow, and 4 Ordinary Fellows have resigned. 27 Ordinary Fellows and 11 Honorary Fellows (6 British and 5 Foreign) were elected.

Invitations were received, and the Society was represented as follows on the occasions mentioned:—

1. Meeting to consider formation of Freshwater Biological Association in London, on February 21, 1930. Professor J. H. ASHWORTH.
2. Second International Congress for Sex Research, London, August 3 to 9, 1930. Professor F. A. E. CREW and Dr B. P. WIEGNER.
3. International Botanical Congress (Discussions on Nomenclature), Cambridge, 16 to 23 August. Professor W. WRIGHT SMITH.
4. Centenary of the Royal Geographical Society, London, October 21, 1930, and two following days. Professor D'ARCY W. THOMPSON.

The undernoted gentlemen were appointed to represent the Society on the National Committee for the Biological Sciences—Professor J. GRAHAM KERR (until December 31, 1930), Professor J. H. ASHWORTH (until December 31, 1933).

Correspondence was received from the Foreign Office in regard to International Co-operation in the Scientific Study of the Polar Regions during a year to be called the "Polar Year." The GENERAL SECRETARY, Dr A. CRICHTON MITCHELL, and Mr J. M. WORDIE were appointed to represent the Society on a Joint Committee of the Royal Society of London and the Royal Society of Edinburgh, which had been formed to advise as to the feasibility of British collaboration in the project. The Report of this Committee has now been forwarded to the Foreign Office.

Professor T. J. MACKIE, University, Edinburgh, was appointed as the Joint Representative of the Royal Society of Edinburgh and the University of Edinburgh on a consultative Committee consisting of representatives of the India Office, Medical Research Council, Royal Society of London, London School of Hygiene and Tropical Medicine, University of Edinburgh, and the Royal Society of Edinburgh, the object of the Committee being to secure closer liaison between Medical Research Organisations in India and in this country.

The Association of Special Libraries and Information Bureaux has informed the Society that a panel of expert translators has been formed under its auspices.

In response to an appeal from the International Institute of Intellectual Co-operation, the Council decided to allow the name of the Royal Society of Edinburgh to be placed upon a list of offices, collaborating to assist investigators, on the understanding that the Society's position is that of an independent body which has volunteered its assistance.

The BRUCE-PRELLER Request of £100 has been used for binding books in the Library, in addition to £100 from the General Income, with a view to overtaking arrears.

£1000 was received under the will of the late Dr DAVID ANDERSON-BERRY, to be used "for the purposes hereinafter appearing: that is to say: I DIRECT the Society, through its proper officers, to invest the said sum of One Thousand pounds, and apply the accumulated income thereof every third year, reckoned from the date of the payment over of the said legacy, in the first place in the presentation of a gold medal, and in the second place in the payment of a sum of money to the winner for the year of such gold medal, the winner being the person who, in the opinion of the Society, shall be the producer for the year of the best essay on the nature of X-rays and their therapeutical effect on human diseases, on which subject I have worked for twenty years, this bequest to be in remembrance of myself."

New lighting has been installed in the Front Hall and Back Saloon (street floor) and in the Back Saloon, Geological Room, and Colonial Room in the basement.

During the session wooden shelving, costing £27, 17s. 6d., was erected in the basement, and two cases of steel shelving, by Roneo, Ltd., costing £105, in the Back Saloon (street floor), the cost of both being met from the proceeds of the sale of a spare set of *Transactions*, certain duplicates of the *Philosophical Transactions* of the Royal Society of London, and of the *Journal für Praktische Chemie*, together with certain other volumes examined by the Curator and General Secretary, and marked for disposal.

The following prizes were awarded during the session:—

KEITH PRIZE (1927-1929), to Dr CHRISTINA C. MILLER.

NEILL PRIZE (1927-1929), to Professor E. B. BAILEY, F.R.S.

JAMES SCOTT PRIZE (1927-1930), to Professor NIELS BOHR.

BRUCE PRIZE (1930), to Mr N. A. MACKINTOSH, M.Sc., A.R.C.S.

The thanks of the Society are due to the Carnegie Trust for the Universities of Scotland for grants to authors towards the cost of illustrations of papers published by the Society, amounting to £53, 4s. 2d.; and to the Royal Society of London, who dispense the Government Publication Grant, for £250 towards the printing of the *Transactions* and *Proceedings*; also to Professor W. C. M'INTOSH, F.R.S., for a donation of £30 towards the cost of printing his paper in the *Transactions*.

#### TREASURER'S Report:—

The TREASURER in presenting his accounts for the session compared the various items of income and expenditure with those of the previous session, and drew attention to the satisfactory position in regard to arrears of subscriptions, the amount outstanding being lower than it had been for many years. He mentioned that a balance of £100 on account of shelving purchased in 1927 had now been written off.

The PRESIDENT then made some remarks, mentioning that a former PRESIDENT of the Society—Professor F. O. BOWER, F.R.S.—had been PRESIDENT of the British Association meeting at Bristol this year.

The PRESIDENT nominated as Scrutineers of the Ballot, Mr D. T. JONES and Professor F. W. SHARPLEY.

The Ballot for the Election of Council and Office-Bearers was then taken.

Mr J. BARTHOLOMEW moved the adoption of the Reports and the reappointment of Messrs LINDSAY, JAMIESON & HAIDANE, C.A., as auditors for the ensuing Session. These motions were seconded by Mr J. MATHIESON, and approved.

The Scrutineers reported that the Ballot Papers were in order, and the PRESIDENT declared that the following Office-Bearers and Members of Council had been duly elected:—

Professor Sir E. A. SHARPEY-SCHAFER, M.D., D.Sc., LL.D., F.R.S., President.

Professor J. GRAHAM KERR, M.A., F.R.S., F.L.S.

Professor W. WRIGHT SMITH, M.A.

Professor F. G. BAILY, M.A., M.Inst.E.E.

Professor T. J. JERU, M.A., M.D., F.G.S.

Professor J. H. ANHWORTH, D.Sc., F.R.S.

ARTHUR LOGAN TURNER, M.D., LL.D., F.R.C.S.E.

Professor R. A. SAMPSON, M.A., D.Sc., LL.D., F.R.S., General Secretary.

Professor O. G. DARWIN, M.A., F.R.S.

Professor JAMES RITCHIE, M.A., D.Sc.

JAMES WATT, W.S., F.F.A., LL.D., Treasurer.

Professor D'ARCY W. THOMPSON, C.B., D.Litt., F.R.S., Curator of Library and Museum.

} Vice-Presidents.

} Secretaries to Ordinary Meetings.



## ORDINARY MEMBERS OF COUNCIL.

J. B. CLARK, M.A., LL.D., J.P.	JAMES DREVER, M.A., B.Sc., D.Phil.
Professor F. A. E. CREW, M.D., Ch.B., D.Sc., Ph.D.	A. H. R. GOLDIE, M.A., B.A.
Professor J. MONTAGU F. DRUMMOND, M.A.	ROBERT ALEX. HOUSTOUN, M.A., Ph.D., D.Sc.
DAVID ALAN STEVENSON, B.Sc., M.Inst.C.E.	The Hon. LORD SANDS, Kt., K.C., LL.D., D.D.
Professor H. W. TURNBULL, M.A.	MURRAY MACGREGOR, M.A., B.Sc.
Sir JAMES WALKER, Kt., D.Sc., LL.D., F.R.S.	A. ORIGHTON MITCHELL, D.Sc.

The PRESIDENT, before closing the meeting, thanked the Scrutineers for their services.

**THE KEITH, MAKDOUGALL-BRISBANE, NEILL, GUNNING  
VICTORIA JUBILEE, JAMES SCOTT, BRUCE, AND  
DAVID ANDERSON-BERRY PRIZES, AND THE BRUCE-  
PRELLER LECTURE FUND.**

The above Prizes will be awarded by the Council in the following manner :—

**I. KEITH PRIZE.**

The KEITH PRIZE, consisting of a Gold Medal and from £40 to £50 in Money, will be awarded in the Session 1931-1932 for the "best communication on a scientific subject, communicated,\* in the first instance, to the Royal Society of Edinburgh during the Sessions 1929-1930 and 1930-1931." Preference will be given to a paper containing a discovery. (See also Council's resolutions at the end of these regulations.)

**II. MAKDOUGALL-BRISBANE PRIZE**

*(Amended June 7, 1928.)*

This Prize is to be awarded biennially by the Council of the Royal Society of Edinburgh to such person, for such purposes, for such objects, and in such manner as shall appear to them the most conducive to the promotion of the interests of science; with the *proviso* that the Council shall not be compelled to award the Prize unless there shall be some individual engaged in scientific pursuit, or some paper written on a scientific subject, or some discovery in science made during the biennial period, of sufficient merit or importance in the opinion of the Council to be entitled to the Prize.

1. The Prize, consisting of a Gold Medal and a sum of Money, will be awarded before the close of the Session 1932-1933, for an Essay, Paper, or other work having reference to any branch of scientific inquiry, either material or mental.

2. It is open to all men of science.

3. The specific subjects taken into consideration in the current award are governed by the resolutions of the Council as stated at the end of these regulations.

4. For the current period the Committee is representative of Group A.

5. The Committee will consider papers presented to the Society within the Sessions 1930-1931 and 1931-1932, and will make a recommendation.

It is empowered to recommend either :—

- (a) An award to the Author of an Essay or Paper considered as above, or
- (b) That no award be made on the ground that, within its group, no paper of sufficient merit has been presented, or
- (c) That the Prize be awarded to some distinguished man of learning, who may not have presented a paper to the Society within the period considered, but who is willing to deliver an address.

\* For the purposes of this award the word "communicated" shall be understood to mean the date on which the manuscript of a paper is received in its final form for printing, as recorded by the General Secretary or other responsible official.

## III. NEILL PRIZE.

The Council of the Royal Society of Edinburgh having received the bequest of the late Dr PATRICK NEILL of the sum of £500, for the purpose of "the interest thereof being applied in furnishing a Medal or other reward every second or third year to any distinguished Scottish Naturalist, according as such Medal or reward shall be voted by the Council of the said Society," hereby intimate:

1. The NEILL PRIZE, consisting of a Gold Medal and a sum of Money, will be awarded during the Session 1931-1932.

2. The Prize will be given for a Paper of distinguished merit, on a subject of Natural History, by a Scottish Naturalist, which shall have been presented \* to the Society during the two years preceding the fourth Monday in October 1931,—or failing presentation of a paper sufficiently meritorious, it will be awarded for a work or publication by some distinguished Scottish Naturalist, on some branch of Natural History, bearing date within five years of the time of award. (See also Council's resolutions at the end of these regulations.)

## IV. GUNNING VICTORIA JUBILEE PRIZE.

This Prize, founded in the year 1887 by Dr R. H. GUNNING, is to be awarded quadrennially by the Council of the Royal Society of Edinburgh, in recognition of original work in Physics, Chemistry, or Pure or Applied Mathematics.

Evidence of such work may be afforded either by a Paper presented \* to the Society, or by a Paper on one of the above subjects, or some discovery in them elsewhere communicated or made, which the Council may consider to be deserving of the Prize.

The Prize consists of a sum of money, and is open to men of science resident in or connected with Scotland. The first award was made in the year 1887. The next award will be made in Session 1932-1933.

In accordance with the wish of the Donor, the Council of the Society may on fit occasions award the Prize for work of a definite kind to be undertaken during the three succeeding years by a scientific man of recognised ability.

## V. JAMES SCOTT PRIZE.

This Prize, founded in the year 1918 by the Trustees of the JAMES SCOTT Bequest, is to be awarded triennially, or at such intervals as the Council of the Royal Society of Edinburgh may decide, "for a lecture or essay on the fundamental concepts of Natural Philosophy."

## VI. BRUCE PRIZE.

The Royal Society is trustee of a fund, instituted in 1923, to commemorate the work of Dr W. S. BRUCE as an explorer and scientific investigator in polar regions.

The Committee of Award is appointed jointly by the Royal Society, the Royal Physical Society, and the Royal Scottish Geographical Society.

\* For the purposes of this award the word "presented" shall be understood to mean the date on which the manuscript of a paper is received in its final form for printing, as reported by the General Secretary or other responsible official.

The Prize consists of a Bronze Medal and sum of money. It is open to workers of all nationalities, with a preference, *ceteris paribus*, for those of Scottish birth or origin, and is to be awarded biennially for some notable contribution to Natural Sciences, such as Zoology, Botany, Geology, Meteorology, Oceanography, and Geography; the contribution to be in the nature of new knowledge, the outcome of a personal visit to polar regions on the part of the recipient. The recipient shall preferably be at the outset of his career as an investigator.

The next award will be made in 1932. Papers for the consideration of the Committee should be in the hands of the General Secretary of the Royal Society, 22 George Street, Edinburgh, not later than March 31 of that year.

#### VII. BRUCE-PRELLER LECTURE FUND.

The Council of the Royal Society of Edinburgh having received in 1929 the bequest of the late Dr Charles Du Riche Preller of the sum of £500, decided that the income thereof be applied by the Council biennially as an honorarium for a special BRUCE-PRELLER Lecture or Address by an outstanding man of science, its subject to be geology or electrical or physical science, or in the discretion of the Council some other branch of science. The first award will be made in session 1930-1931.

#### VIII. DAVID ANDERSON-BERRY FUND.

The Council of the Royal Society of Edinburgh having received in the year 1930, free of duty, the capital sum of one thousand pounds (£1000), to be used in terms of the will of the late Dr David Anderson-Berry, dated 23rd April 1926, decided that the income thereof be applied triennially, "in the first place in the presentation of a gold medal, and in the second place in the payment of a sum of money to the winner for the year of such gold medal, the winner being the person who, in the opinion of the Society, shall be the producer for the year of the best essay on the nature of X-rays and their therapeutical effect on human diseases."

#### RESOLUTIONS OF COUNCIL IN REGARD TO THE MODE OF AWARDING PRIZES.

(See Minutes of Meeting of January 18, 1915.)

I. With regard to the Keith and Makdougall-Brishane Prizes, which are open to all Sciences, the mode of award will be as follows:—

1. Papers or essays to be considered shall be arranged in two groups, A and B,  
—Group A to include Astronomy, Chemistry, Mathematics, Metallurgy, Meteorology and Physics; Group B to include Anatomy, Anthropology, Botany, Geology, Pathology, Physiology, and Zoology.
2. These two Prizes shall be awarded to each group in alternate biennial periods, provided papers worthy of recommendation have been communicated to the Society.

3. Prior to the adjudication the Council shall appoint, in the first instance, a Committee composed of representatives of the group of Sciences which did not receive the award in the immediately preceding period. The Committee shall consider the Papers which come within their group of Sciences, and report in due course to the Council.
  4. In the event of the aforesaid Committee reporting that within their group of subjects there is, in their opinion, no paper worthy of being recommended for the award, the Council, on accepting this report, shall appoint a Committee representative of the alternate group to consider papers coming within their group and to report accordingly.
  5. Papers to be considered by the Committees shall fall within the period dating from the last award in groups A and B respectively.
- II. With regard to the Neill Prize, the term "Naturalist" shall be understood to include any student in the Sciences composing group B, namely, Anatomy, Anthropology, Botany, Geology, Pathology, Physiology, Zoology.

## AWARDS OF THE KEITH, MAKDOUGALL-BRISBANE, NEILL, GUNNING, JAMES SCOTT, BRUCE, AND DAVID ANDERSON-BERRY PRIZES, AND THE BRUCE- PRELLER LECTURE FUND.

### I. KEITH PRIZE.

- 1ST BIENNIAL PERIOD, 1827-29.—Dr BREWSTER, for his papers "on his Discovery of Two New Immiscible Fluids in the Cavities of certain Minerals," published in the Transactions of the Society.
- 2ND BIENNIAL PERIOD, 1829-31.—Dr BREWSTER, for his paper "on a New Analysis of Solar Light," published in the Transactions of the Society.
- 3RD BIENNIAL PERIOD, 1831-33.—THOMAS GRAHAM, Esq., for his paper "on the Law of the Diffusion of Gases," published in the Transactions of the Society.
- 4TH BIENNIAL PERIOD, 1833-35.—Professor J. D. FORBES, for his paper "on the Refraction and Polarization of Heat," published in the Transactions of the Society.
- 5TH BIENNIAL PERIOD, 1835-37.—JOHN SCOTT RUSSELL, Esq., for his researches "on Hydrodynamics," published in the Transactions of the Society.
- 6TH BIENNIAL PERIOD, 1837-39.—Mr JOHN SHAW, for his experiments "on the Development and Growth of the Salmon," published in the Transactions of the Society.
- 7TH BIENNIAL PERIOD, 1839-41.—Not awarded.
- 8TH BIENNIAL PERIOD, 1841-43.—Professor JAMES DAVID FORBES, for his papers "on Glaciers," published in the Proceedings of the Society.
- 9TH BIENNIAL PERIOD, 1843-45.—Not awarded.
- 10TH BIENNIAL PERIOD, 1845-47.—General Sir THOMAS BRISBANE, Bart., for the Makerstoun Observations on Magnetic Phenomena, made at his expense, and published in the Transactions of the Society.
- 11TH BIENNIAL PERIOD, 1847-49.—Not awarded.
- 12TH BIENNIAL PERIOD, 1849-51.—Professor KELLAND, for his papers "on General Differentiation, including his more recent Communication on a process of the Differential Calculus, and its application to the solution of certain Differential Equations," published in the Transactions of the Society.
- 13TH BIENNIAL PERIOD, 1851-53.—W. J. MACQUORN RANKINE, Esq., for his series of papers "on the Mechanical Action of Heat," published in the Transactions of the Society.
- 14TH BIENNIAL PERIOD, 1853-55.—Dr THOMAS ANDERSON, for his papers "on the Crystalline Constituents of Opium, and on the Products of the Destructive Distillation of Animal Substances," published in the Transactions of the Society.
- 15TH BIENNIAL PERIOD, 1855-57.—Professor BOOLE, for his Memoir "on the Application of the Theory of Probabilities to Questions of the Combination of Testimonies and Judgments," published in the Transactions of the Society.
- 16TH BIENNIAL PERIOD, 1857-59.—Not awarded.
- 17TH BIENNIAL PERIOD, 1859-61.—JOHN ALLAN BROWN, Esq., F.R.S., Director of the Trevandrum Observatory, for his papers "on the Horizontal Force of the Earth's Magnetism, on the Correction of the Bifilar Magnetometer, and on Terrestrial Magnetism generally," published in the Transactions of the Society.
- 18TH BIENNIAL PERIOD, 1861-63.—Professor WILLIAM THOMSON, of the University of Glasgow, for his Communication "on some Kinematical and Dynamical Theorems."
- 19TH BIENNIAL PERIOD, 1863-65.—Principal FORBES, St Andrews, for his "Experimental Inquiry into the Laws of Conduction of Heat in Iron Bars," published in the Transactions of the Society.
- 20TH BIENNIAL PERIOD, 1865-67.—Professor C. PIAZZI SMYTH, for his paper "on Recent Measures at the Great Pyramid," published in the Transactions of the Society.
- 21ST BIENNIAL PERIOD, 1867-69.—Professor P. G. TAIT, for his paper "on the Rotation of a Rigid Body about a Fixed Point," published in the Transactions of the Society.

- 22ND BIENNIAL PERIOD, 1869-71.—Professor CLERK MAXWELL, for his paper "on Figures, Frames, and Diagrams of Forces," published in the Transactions of the Society.
- 23RD BIENNIAL PERIOD, 1871-73.—Professor P. G. TAIT, for his paper entitled "First Approximation to a Thermo-electric Diagram," published in the Transactions of the Society.
- 24TH BIENNIAL PERIOD, 1873-1875.—Professor CRUM BROWN, for his Researches "on the Sense of Rotation, and on the Anatomical Relations of the Semicircular Canals of the Internal Ear."
- 25TH BIENNIAL PERIOD, 1875-77.—Professor M. FORSTER HEDDLE, for his papers "on the Rhombohedral Carbonates," and "on the Felspars of Scotland," published in the Transactions of the Society.
- 26TH BIENNIAL PERIOD, 1877-79.—Professor H. C. FLEMING JENKIN, for his paper "on the Application of Graphic Methods to the Determination of the Efficiency of Machinery," published in the Transactions of the Society; Part II having appeared in the volume for 1877-78.
- 27TH BIENNIAL PERIOD, 1879-81.—Professor GEORGE CHRYSTAL, for his paper "on the Differential Telephone," published in the Transactions of the Society.
- 28TH BIENNIAL PERIOD, 1881-83.—THOMAS MUIR, Esq., LL.D., for his "Researches into the Theory of Determinants and Continued Fractions," published in the Proceedings of the Society.
- 29TH BIENNIAL PERIOD, 1883-85.—JOHN AITKEN, Esq., for his paper "on the Formation of Small Clear Spaces in Dusty Air," and for previous papers on Atmospheric Phenomena, published in the Transactions of the Society.
- 30TH BIENNIAL PERIOD, 1885-87.—JOHN YOUNG BUCHANAN, Esq., for a series of communications, extending over several years, on subjects connected with Ocean Circulation, Compressibility of Glass, etc.; two of which, viz., "On Ice and Brines," and "On the Distribution of Temperature in the Antarctic Ocean," have been published in the Proceedings of the Society.
- 31ST BIENNIAL PERIOD, 1887-89.—Professor E. A. LETTS, for his papers on the Organic Compounds of Phosphorus, published in the Transactions of the Society.
- 32ND BIENNIAL PERIOD, 1889-91.—R. T. OMOND, Esq., for his contributions to Meteorological Science, many of which are contained in vol. xxxiv of the Society's Transactions.
- 33RD BIENNIAL PERIOD, 1891-93.—Professor THOMAS R. FRASER, F.R.S., for his papers on *Strophanthus hispidus*, Strophanthin, and Strophanthidin, read to the Society in February and June 1889 and in December 1891, and printed in vols. xxxv, xxxvi, and xxxvii of the Society's Transactions.
- 34TH BIENNIAL PERIOD, 1893-95.—Dr CAROLL G. KNOTT, for his papers on the Strains produced by Magnetism in Iron and in Nickel, which have appeared in the Transactions and Proceedings of the Society.
- 35TH BIENNIAL PERIOD, 1895-97.—Dr THOMAS MUIR, for his continued communications on Determinants and Allied Questions.
- 36TH BIENNIAL PERIOD, 1897-99.—Dr JAMES BURGESS, for his paper "on the Definite Integral  $\frac{2}{\sqrt{\pi}} \int_0^1 e^{-x^2} dx$ , with extended Tables of Values," printed in vol. xxxix of the Transactions of the Society.
- 37TH BIENNIAL PERIOD, 1899-1901.—Dr HUGH MARSHALL, for his discovery of the Persulphates, and for his Communications on the Properties and Reactions of these Salts, published in the Proceedings of the Society.
- 38TH BIENNIAL PERIOD, 1901-03.—Sir WILLIAM TURNER, K.C.B., LL.D., F.R.S., etc., for his memoirs entitled "A Contribution to the Craniology of the People of Scotland," published in the Transactions of the Society, and for his "Contributions to the Craniology of the People of the Empire of India," Parts I, II, likewise published in the Transactions of the Society.
- 39TH BIENNIAL PERIOD, 1903-05.—THOMAS H. BRYCE, M.A., M.D., for his two papers on "The Histology of the Blood of the Larva of *Lepidosiren paradoxa*," published in the Transactions of the Society within the period.
- 40TH BIENNIAL PERIOD, 1905-07.—ALEXANDER BRUCE, M.A., M.D., F.R.C.P.E., for his paper entitled "Distribution of the Cells in the Intermedio-Lateral Tract of the Spinal Cord," published in the Transactions of the Society within the period.
- 41ST BIENNIAL PERIOD, 1907-09.—WHEELTON HIND, M.D., B.S., F.R.C.S., F.G.S., for a paper published in the Transactions of the Society, "On the Lamellibranch and Gasteropod Fauna found in the Millstone Grit of Scotland."

- 42ND BIENNIAL PERIOD, 1909-11.—Professor ALEXANDER SMITH, B.Sc., Ph.D., of New York, for his researches upon "Sulphur" and upon "Vapour Pressure," appearing in the Proceedings of the Society.
- 43RD BIENNIAL PERIOD, 1911-1913.—JAMES RUSSELL, Esq., for his series of investigations relating to magnetic phenomena in metals and the molecular theory of magnetism, the results of which have been published in the Proceedings and Transactions of the Society, the last paper having been issued within the period.
- 44TH BIENNIAL PERIOD, 1913-15.—JAMES HARTLEY ASHWORTH, D.Sc., for his papers on "Larve of Lingula and Pelagodiscus," and on "Sclerocheilus," published in the Transactions of the Society, and for other papers on the Morphology and Histology of Polychæta.
- 45TH BIENNIAL PERIOD, 1915-17.—ROBERT C. MOSSMAN, for his work on the Meteorology of the Antarctic Regions, which originated with the important series of observations made by him during the voyage of the "Scotia" (1902-1904), and includes his paper "On a Sea-Saw of Barometric Pressure, Temperature, and Wind Velocity between the Weddell Sea and the Ross Sea," published in the Proceedings of the Society.
- 46TH BIENNIAL PERIOD, 1917-19.—JOHN STEPHENSON, Lt.-Col. I.M.S., for his series of papers on the Oligochaeta and other Annelida, several of which have been published in the Transactions of the Society.
- 47TH BIENNIAL PERIOD, 1919-21.—RALPH ALLEN SAMPSON, F.R.S., for his Astronomical Researches, including the papers "Studies in Clocks and Time-keeping: No. 1, Theory of the Maintenance of Motion; No. 2, Tables of the Circular Equation," published in the Proceedings of the Society within the period of the award.
- 48TH BIENNIAL PERIOD, 1921-23.—JOHN WALTER GREGORY, F.R.S., for his papers published in the Transactions of the Society, and in recognition of his numerous contributions to Geology, extending over a period of thirty-six years.
- 49TH BIENNIAL PERIOD, 1923-25.—HERBERT WESTREN TURNBULL, M.A., for the papers on "Hyper-Algebra," "Invariant Theory," and "Algebraic Geometry," three of which have been published in the Proceedings within the period of award.
- 50TH BIENNIAL PERIOD, 1925-27.—THOMAS JOHN JERU, M.A., M.D., F.G.S., and ROBERT MELDRUM CRAIG, M.A., B.Sc., F.G.S., for the joint series of papers which have recently appeared in the Transactions of the Society on the "Geology of the Outer Hebrides."
- 51ST BIENNIAL PERIOD, 1927-29.—Dr CHRISTINA C. MILLER, B.Sc., for her papers on the "Slow Oxidation of Phosphorus Trioxide," published in the Proceedings within the period of the award, and in consideration of subsequent developments on "Slow Oxidation of Phosphorus," published elsewhere.

## II. MAKDOUGALL-BRISBANE PRIZE.

- 1ST BIENNIAL PERIOD, 1859.—Sir RODERICK IMPEY MURCHISON, on account of his Contributions to the Geology of Scotland.
- 2ND BIENNIAL PERIOD, 1860-62.—WILLIAM SELLER, M.D., F.R.C.P.E., for his "Memoir of the Life and Writings of Dr Robert Whytt," published in the Transactions of the Society.
- 3RD BIENNIAL PERIOD, 1862-64.—JOHN DENIS MACDONALD, Esq., R.N., F.R.S., Surgeon of H.M.S. "Icarus," for his paper "on the Representative Relationships of the Fixed and Free Tunicata, regarded as Two Sub-classes of equivalent value; with some General Remarks on their Morphology," published in the Transactions of the Society.
- 4TH BIENNIAL PERIOD, 1864-66.—Not awarded.
- 5TH BIENNIAL PERIOD, 1866-68.—Dr ALEXANDER CRUM BROWN and Dr THOMAS RICHARD FRASER, for their conjoint paper "on the Connection between Chemical Constitution and Physiological Action," published in the Transactions of the Society.
- 6TH BIENNIAL PERIOD, 1868-70.—Not awarded.
- 7TH BIENNIAL PERIOD, 1870-72.—GEORGE JAMES ALLMAN, M.D., F.R.S., Emeritus Professor of Natural History, for his paper "on the Homological Relations of the Coelenterata," published in the Transactions, which forms a leading chapter of his Monograph of Gymnoblæstic or Tubularian Hydroids—since published.
- 8TH BIENNIAL PERIOD, 1872-74.—Professor LISTER, for his paper "on the Germ Theory of Putrefaction and the Fermentive Changes," communicated to the Society, 7th April 1873.
- 9TH BIENNIAL PERIOD, 1874-76.—ALEXANDER BUCHAN, A.M., for his paper "on the Diurnal Oscillation of the Barometer," published in the Transactions of the Society.



- 10TH BIENNIAL PERIOD, 1876-78.—Professor ARCHIBALD GEIKIE, for his paper "on the Old Red Sandstone of Western Europe," published in the Transactions of the Society.
- 11TH BIENNIAL PERIOD, 1878-80.—Professor PIAZZI SMYTH, Astronomer-Royal for Scotland, for his paper "on the Solar Spectrum in 1877-78, with some Practical Idea of its probable Temperature of Origination," published in the Transactions of the Society.
- 12TH BIENNIAL PERIOD, 1880-82.—Professor JAMES GEIKIE, for his "Contributions to the Geology of the North-West of Europe," including his paper "on the Geology of the Faroes," published in the Transactions of the Society.
- 13TH BIENNIAL PERIOD, 1882-84.—EDWARD SANG, Esq., LL.D., for his paper "on the Need of Decimal Subdivisions in Astronomy and Navigation, and on Tables requisite therefor," and generally for his Recalculations of Logarithms both of Numbers and Trigonometrical Ratios, —the former communication being published in the Proceedings of the Society.
- 14TH BIENNIAL PERIOD, 1884-86.—JOHN MURRAY, Esq., LL.D., for his papers "On the Drainage Areas of Continents, and Ocean Deposits," "The Rainfall of the Globe, and Discharge of Rivers," "The Height of the Land and Depth of the Ocean," and "The Distribution of Temperature in the Scottish Lochs as affected by the Wind."
- 15TH BIENNIAL PERIOD, 1886-88.—ARCHIBALD GEIKIE, Esq., LL.D., for numerous Communications, especially that entitled "History of Volcanic Action during the Tertiary Period in the British Isles," published in the Transactions of the Society.
- 16TH BIENNIAL PERIOD, 1888-90.—Dr LUDWIG BECKER, for his paper on "The Solar Spectrum at Medium and Low Altitudes," printed in vol. xxxvi, Part I, of the Society's Transactions.
- 17TH BIENNIAL PERIOD, 1890-92.—HUGH ROBERT MILL, Esq., D.Sc., for his papers on "The Physical Conditions of the Clyde Sea Area," Part I being already published in vol. xxxvi of the Society's Transactions.
- 18TH BIENNIAL PERIOD, 1892-94.—Professor JAMES WALKER, D.Sc., Ph.D., for his work on Physical Chemistry, part of which has been published in the Proceedings of the Society, vol. xx, pp. 255-263. In making this award, the Council took into consideration the work done by Professor Walker along with Professor Crum Brown on the Electrolytic Synthesis of Dibasic Acids, published in the Transactions of the Society.
- 19TH BIENNIAL PERIOD, 1894-96.—Professor JOHN G. M'KENDRICK, for numerous Physiological papers, especially in connection with Sound, many of which have appeared in the Society's publications.
- 20TH BIENNIAL PERIOD, 1896-98.—Dr WILLIAM PEDDIE, for his papers on the Torsional Rigidity of Wires.
- 21ST BIENNIAL PERIOD, 1898-1900.—Dr RAMSAY H. TRAQUAIR, for his paper entitled "Report on Fossil Fishes collected by the Geological Survey in the Upper Silurian Rocks of Scotland," printed in vol. xxxix of the Transactions of the Society.
- 22ND BIENNIAL PERIOD, 1900-02.—Dr ARTHUR T. MASTERMAN, for his paper entitled "The Early Development of *Cribrella oculata* (Forbes), with remarks on Echinoderm Development," printed in vol. xl of the Transactions of the Society.
- 23RD BIENNIAL PERIOD, 1902-04.—Mr JOHN DOUGALL, M.A., for his paper on "An Analytical Theory of the Equilibrium of an Isotropic Elastic Plate," published in vol. xli of the Transactions of the Society.
- 24TH BIENNIAL PERIOD, 1904-06.—JACOB E. HALM, Ph.D., for his two papers entitled "Spectroscopic Observations of the Rotation of the Sun," and "Some Further Results obtained with the Spectroheliometer," and for other astronomical and mathematical papers published in the Transactions and Proceedings of the Society within the period.
- 25TH BIENNIAL PERIOD, 1906-08.—D. T. GWYNNE-VAUGHAN, M.A., F.L.S., for his papers, 1st, "On the Fossil Osmundaceae," and 2nd, "On the Origin of the Adaxially-curved Leaf-trace in the Filicales," communicated by him conjointly with Dr R. Kidston.
- 26TH BIENNIAL PERIOD, 1908-10.—ERNEST MACLAGAN WEDDERBURN, M.A., LL.B., for his series of papers bearing upon "The Temperature Distribution in Fresh-water Lochs," and especially upon "The Temperature Seiche."
- 27TH BIENNIAL PERIOD, 1910-12.—JOHN BROWNEER, M.A., M.D., D.Sc., for his contributions to the Theory of Mendelian Distributions and cognate subjects, published in the Proceedings of the Society within and prior to the prescribed period.
- 28TH BIENNIAL PERIOD, 1912-14.—Professor C. R. MARSHALL, M.D., M.A., for his studies "On the Pharmacological Action of Tetra-alkyl-ammonium Compounds."

- 29TH BIENNIAL PERIOD, 1914-16.—ROBERT ALEXANDER HOUSTOUN, Ph.D., D.Sc., for his series of papers on "The Absorption of Light by Inorganic Salts," published in the Proceedings of the Society.
- 30TH BIENNIAL PERIOD, 1916-18.—Professor A. ANSTRUTHER LAWSON, for his Memoirs on "The Prothalli of *Tmesipteria Tannensis* and of *Psilotum*," published in the Transactions of the Society, together with previous papers on Cytology and on The Gametophytes of various Gymnosperms.
- 31ST BIENNIAL PERIOD, 1918-20.—Professor J. H. MACLAGAN WEDDERBURN of Princeton University for his Memoirs in Universal Algebra, etc., published in the Transactions and Proceedings of the Society, and elsewhere.
- 32ND BIENNIAL PERIOD, 1920-22.—Professor W. T. GORDON, M.A., D.Sc., for his paper on "Cambrian Organic Remains from a Dredging in the Weddell Sea," published in the Transactions of the Society within the period, and for his investigations on the Fossil Flora of the Pettycur Limestone, previously published in the Transactions.
- 33RD BIENNIAL PERIOD, 1922-24.—Professor H. STANLEY ALLEN, D.Sc., for his papers on the "Quantum and Atomic Theory," published in the Society's Proceedings within the period.
- 34TH BIENNIAL PERIOD, 1924-26.—Dr CHARLES MORLEY WENYON, C.M.G., C.B.E., F.R.S. for his distinguished work in Protozoology extending over a period of twenty-one years.
- 35TH BIENNIAL PERIOD, 1926-28.—Dr W. O. KERMACK, M.A., for his contributions to Chemistry, published in the Society's Proceedings and elsewhere.

### III. THE NEILL PRIZE.

- 1ST TRIENNIAL PERIOD, 1856-59.—Dr W. LAUDER LINDSAY, for his paper "on the Spermatogones and Pycnides of Filamentous, Fruticose, and Foliose Lichens," published in the Transactions of the Society.
- 2ND TRIENNIAL PERIOD, 1859-62.—ROBERT KAYE GREVILLE, LL.D., for his contributions to Scottish Natural History, more especially in the department of Cryptogamic Botany, including his recent papers on Diatomaceæ.
- 3RD TRIENNIAL PERIOD, 1862-65.—ANDREW CROMBIE RAMSAY, F.R.S., Professor of Geology in the Government School of Mines, and Local Director of the Geological Survey of Great Britain, for his various works and memoirs published during the last five years, in which he has applied the large experience acquired by him in the Direction of the arduous work of the Geological Survey of Great Britain to the elucidation of important questions bearing on Geological Science.
- 4TH TRIENNIAL PERIOD, 1865-68.—Dr WILLIAM CARMICHAEL M'INTOSH, for his paper "on the Structure of the British Nemerteans, and on some New British Annelids," published in the Transactions of the Society.
- 5TH TRIENNIAL PERIOD, 1868-71.—Professor WILLIAM TURNER, for his papers "on the Great Finner Whale; and on the Gravid Uterus, and the Arrangement of the Fetal Membranes in the Cetaceæ," published in the Transactions of the Society.
- 6TH TRIENNIAL PERIOD, 1871-74.—CHARLES WILLIAM PEACH, Esq., for his Contributions to Scottish Zoology and Geology, and for his recent contributions to Fossil Botany.
- 7TH TRIENNIAL PERIOD, 1874-77.—Dr RAMSAY H. TRAQUAIR, for his paper "on the Structure and Affinities of *Tristichopterus alatus* (Egerton)," published in the Transactions of the Society, and also for his contributions to the Knowledge of the Structure of Recent and Fossil Fishes.
- 8TH TRIENNIAL PERIOD, 1877-80.—JOHN MURRAY, Esq., for his paper "on the Structure and Origin of Coral Reefs and Islands," published (in abstract) in the Proceedings of the Society.
- 9TH TRIENNIAL PERIOD, 1880-83.—Professor HERDMAN, for his papers "on the Tunicata," published in the Proceedings and Transactions of the Society.
- 10TH TRIENNIAL PERIOD, 1883-86.—B. N. PEACH, Esq., for his Contributions to the Geology and Palæontology of Scotland, published in the Transactions of the Society.
- 11TH TRIENNIAL PERIOD, 1886-89.—ROBERT KIDSTON, Esq., for his Researches in Fossil Botany, published in the Transactions of the Society.
- 12TH TRIENNIAL PERIOD, 1889-92.—JOHN HORNE, Esq., F.G.S., for his Investigations into the Geological Structure and Petrology of the North-West Highlands.

- 13TH TRIENNIAL PERIOD, 1892-95.—ROBERT IRVINE, Esq., for his papers on the Action of Organisms in the Secretion of Carbonate of Lime and Silica, and on the solution of these substances in Organic Juices. These are printed in the Society's Transactions and Proceedings.
- 14TH TRIENNIAL PERIOD, 1895-98.—Professor CONNAR EWART, for his recent Investigations connected with Telephony.
- 15TH TRIENNIAL PERIOD, 1898-1901.—Dr JOHN S. FLETT, for his papers entitled "The Old Red Sandstone of the Orkneys" and "The Trap Dykes of the Orkneys," printed in vol. xxxix of the Transactions of the Society.
- 16TH TRIENNIAL PERIOD, 1901-04.—Professor J. GRAHAM KERR, M.A., for his Researches on *Lepidosiren paradoxa*, published in the Philosophical Transactions of the Royal Society, London.
- 17TH TRIENNIAL PERIOD, 1904-07.—FRANK J. COLE, B.Sc., for his paper entitled "A Monograph on the General Morphology of the Myxinoïd Fishes, based on a Study of Myxine," published in the Transactions of the Society, regard being also paid to Mr Cole's other valuable contributions to the Anatomy and Morphology of Fishes.
- 1ST BIENNIAL PERIOD, 1907-09.—FRANCIS J. LEWIS, M.Sc., F.L.S., for his papers in the Society's Transactions "On the Plant Remains of the Scottish Peat Mosses."
- 2ND BIENNIAL PERIOD, 1909-11.—JAMES MURRAY, Esq., for his paper on "Scottish Rotifers collected by the Lake Survey (Supplement)," and other papers on the "Rotifera" and "Tardigrada," which appeared in the Transactions of the Society—(this Prize was awarded after consideration of the papers received within the five years prior to the time of award: see Neill Prize Regulations).
- 3RD BIENNIAL PERIOD, 1911-13.—Dr W. S. BRUCE, in recognition of the scientific results of his Arctic and Antarctic explorations.
- 4TH BIENNIAL PERIOD, 1913-15.—ROBERT CAMPBELL, D.Sc., for his paper on "The Upper Cambrian Rocks at Craigoven Bay, Stonehaven," and "Downtonian and Old Red Sandstone Rocks of Kincardineshire," published in the Transactions of the Society.
- 5TH BIENNIAL PERIOD, 1915-17.—W. H. LANG, F.R.S., M.B., D.Sc., for his paper in conjunction with Dr R. KIDSTON, F.R.S., on *Rhynia Gwynne-Vaughani*, Kidston and Lang, published in the Transactions of the Society, and for his previous investigations on Pteridophytes and Cycads.
- 6TH BIENNIAL PERIOD, 1917-19.—JOHN TAIT, D.Sc., M.D., for his work on Crustacea, published in the Proceedings of the Society, and for his papers on the blood of Crustacea.
- 7TH BIENNIAL PERIOD, 1919-21.—Sir EDWARD A. SHARPEY-SCHAFER, F.R.S., for his recent contributions to our knowledge of Physiology, and in recognition of his published work extending over a period of fifty years.
- 8TH BIENNIAL PERIOD, 1921-23.—JOHN M'LEAN THOMPSON, M.A., D.Sc., University of Liverpool, for his series of Memoirs on Staminal Zygomorphy, and on the Anatomy of the Filicales.
- 9TH BIENNIAL PERIOD, 1923-25.—FREDERICK ORPEN BOWER, F.R.S., for his recent contributions to Botanical knowledge and in recognition of his published work extending over a period of forty-five years.
- 10TH BIENNIAL PERIOD, 1925-27.—ARTHUR ROBINSON, M.D., M.R.C.S., for his contributions to Comparative Anatomy and Embryology.
- 11TH BIENNIAL PERIOD, 1927-29.—Professor ED. BATTERSBY BAILEY, M.C., F.R.S., in recognition of his valuable contributions to the Geology of Scotland, two of which have recently appeared in the Transactions of the Society.

#### IV. GUNNING VICTORIA JUBILEE PRIZE.

- 1ST TRIENNIAL PERIOD, 1884-87.—Sir WILLIAM THOMSON, Pres. R.S.E., F.R.S., for a remarkable series of papers "on Hydrokinetics," especially on Waves and Vortices which have been communicated to the Society.
- 2ND TRIENNIAL PERIOD, 1887-90.—Professor P. G. TAIT, Sec. R.S.E., for his work in connection with the "Challenger" Expedition, and his other Researches in Physical Science.
- 3RD TRIENNIAL PERIOD, 1890-93.—ALEXANDER BUCHAN, Esq., LL.D., for his varied, extensive, and extremely important Contributions to Meteorology, many of which have appeared in the Society's publications.

- 4TH TRIENNIAL PERIOD, 1893-96.—JOHN AITKEN, Esq., for his brilliant investigations in Physics, especially in connection with the Formation and Condensation of Aqueous Vapour.
- 1ST QUADRENNIAL PERIOD, 1896-1900.—Dr T. D. ANDERSON, for his discoveries of New and Variable Stars.
- 2ND QUADRENNIAL PERIOD, 1900-04.—Sir JAMES DEWAR, LL.D., D.C.L., F.R.S., etc., for his researches on the Liquefaction of Gases, extending over the last quarter of a century, and on the Chemical and Physical Properties of Substances at Low Temperatures: his earliest papers being published in the Transactions and Proceedings of the Society.
- 3RD QUADRENNIAL PERIOD, 1904-08.—Professor GEORGE CHRYSTAL, M.A., LL.D., for a series of papers on "Seiches," including "The Hydrodynamical Theory and Experimental Investigations of the Seiche Phenomena of Certain Scottish Lakes."
- 4TH QUADRENNIAL PERIOD, 1908-12.—Professor J. NORMAN COLLIE, Ph.D., F.R.S., for his distinguished contributions to Chemistry, Organic and Inorganic, during twenty-seven years, including his work upon Neon and other rare gases. Professor Collie's early papers were contributed to the Transactions of the Society.
- 5TH QUADRENNIAL PERIOD, 1912-16.—Sir THOS. MUIR, C.M.G., LL.D., F.R.S., for his series of Memoirs upon "The Theory and History of Determinants and Allied Forms," published in the Transactions and Proceedings of the Society between the years 1872 and 1915.
- 6TH QUADRENNIAL PERIOD, 1916-20.—C. T. R. WILSON, Esq., F.R.S., in recognition of his important discoveries in relation to Condensation Nuclei, Ionisation of Gases, and Atmospheric Electricity.
- 7TH QUADRENNIAL PERIOD, 1920-24.—Sir J. J. THOMSON, O.M., F.R.S., in recognition of his great discoveries in Physical Science.
- 8TH QUADRENNIAL PERIOD, 1924-28.—Professor E. T. WHITTAKER, F.R.S., in recognition of his distinguished contributions to Mathematical Science, and of his promotion of Mathematical Research in Scotland.

#### V. JAMES SCOTT PRIZE.

- 1ST AWARD, 1918-22.—Professor A. N. WHITEHEAD, F.R.S., for his lecture delivered on June 5, 1922, "On the Relatedness of Nature."
- 2ND AWARD, 1922-27.—Sir JOSEPH LARMOR, M.A., D.Sc., LL.D., F.R.S., for his lecture delivered on July 4, 1927, on "The Grasp of Mind on Nature."
- 3RD AWARD, 1927-30.—Professor NIELS BOHR, for his lecture delivered on May 26, 1930, on "Philosophical Aspects of Atomic Theory."

#### VI. BRUCE PRIZE.

- 1ST AWARD 1926.—JAMES MANN WORDIE, M.A., for his Oceanographical and Geological work in both Polar Regions.
- 2ND AWARD, 1928.—H. U. SVERDRUP, for his contributions to the knowledge of the Meteorology, Magnetism, and Tides of the Arctic, as an outcome of his travels with the Norwegian Expedition in the "Maud" from 1918 to 1925.
- 3RD AWARD, 1930.—N. A. MACKINTOSH, M.Sc., A.R.C.S., for his researches into the Biology of Whales in the Waters of the Falkland Islands Dependencies.

#### VII. BRUCE-PRELLER LECTURE FUND.

#### VIII. DAVID ANDERSON-BERRY FUND.

**ABSTRACT**  
OF  
**THE ACCOUNTS**  
OF  
**THE ROYAL SOCIETY OF EDINBURGH,**  
**SESSION — 1ST OCTOBER 1929 TO 30TH SEPTEMBER 1930.**

*JAMES WATT, LL.D., W.S.,*  
*Treasurer.*

**I. GENERAL FUND**

**CHARGE.**

1. Arrears of Contributions at 30th September 1929 . . . . .		£88 4 0
2. Contributions for present Session :—		
1. 378 Fellows at £3, 3s. each . . . . .	£1190 14 0	
2. Fees of Admission and Contributions of twenty-five new Fellows at £6, 6s. each (including one in arrear at 30th September 1929), and Commutation of one new Fellow at £55, 13s. . . . .	213 3 0	
(Two New Fellows' Fees of Admission and Contributions were outstanding, but have since been paid)		1408 17 0
3. Extra Contributions for 1929-30 under Amended Law, No. 6 :—		
1. Voluntary Contributions . . . . .	£46 4 0	
2. Commutation . . . . .	10 10 0	
		56 14 0
4. Interest received—		
a. Interest on £445, 10s. 5% War Loan, 1929-47 (R. M. Smith Legacy), Untaxed . . . . .	£22 5 6	
b. Interest on £751, 16s. 5% War Loan, 1929-47 (Special Subscription Fund), Untaxed. . . . .	37 11 10	
c. General—		
Interest on £7830 5% War Loan, 1929-47, Untaxed . . . . .	£391 10 0	
Interest on £2100 2½% Consolidated Stock, Untaxed . . . . .	52 10 0	
Interest on Deposit Receipts . . . . .	11 9 2	
	455 9 2	515 6 6
5. Transactions and Proceedings sold . . . . .		193 4 6
6. Grants—Annual Grant from Government . . . . .	£200 0 0	
Grant from Royal Society, Government Publications Grant	250 0 0	
		850 0 0
7. Income Tax repaid for year to 5th April 1930 . . . . .		2 12 6
<b>Amount of the Charge . . . . .</b>		<b>£3109 18 6</b>

# Abstract of Accounts

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## DISCHARGE.

### 1. TAXES, INSURANCE, COAL AND LIGHTING :—

Insurance . . . . .	£22 0 8
Coal, etc., to 24th May 1930 . . . . .	39 17 0
Gas to 11th April 1930 . . . . .	3 0 0
Electric Light to 21st April 1930 . . . . .	12 2 11
Water, 1929-30 . . . . .	4 4 0
Equitable Life Assurance Co., Ltd., for Superannuation Scheme	£45 0 0
<i>Less</i> —Received from Assistant Secretary . . . . .	15 0 0
	<hr/>
	30 0 0
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	£111 4 7

### 2. SALARIES :—

General Secretary . . . . .	£100 0 0
Librarian and Assistant Secretary . . . . .	300 0 0
Assistant Librarian . . . . .	130 0 0
Office Keeper . . . . .	151 12 0
Treasurer's Clerk . . . . .	85 0 0
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	716 12 0

### 3. EXPENSES OF TRANSACTIONS AND PROCEEDINGS :—

#### a. TRANSACTIONS :—

Neill & Co., Ltd., Printers . . . . .	£541 13 8
Hislop & Day, Ltd., Engravers . . . . .	88 14 9
The Zinco-Collotype Co. . . . .	55 0 0
M'Farlane & Erskine . . . . .	17 8 0
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	£702 16 5

#### *Less Receipts* :—

Grants by Carnegie Trustees towards Papers, etc., of L. A. Harvey and W. C. M'Intosh	£38 18 5
Received from Prof. W. C. M'Intosh towards his Paper . . . . .	80 0 0
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	68 18 5
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	£633 18 0

#### b. PROCEEDINGS :—

Neill & Co., Ltd., Printers . . . . .	£593 9 3
Hislop & Day, Ltd., Engravers . . . . .	45 5 0
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	£638 14 3

#### *Less Receipts* :—

Grant by Carnegie Trustees towards W. Greenwood's Paper . . . . .	£14 5 9
Revenue of Publication Fund . . . . .	102 11 3
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	116 17 0
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	521 17 3

1155 15 3

### 4. BOOKS, PERIODICALS, NEWSPAPERS, ETC. :—

James Thin, Bookseller . . . . .	£303 15 9
R. Grant & Son, Booksellers . . . . .	3 6 0
Robertson & Scott, News Agents . . . . .	7 7 8
Ray Society, Subscription . . . . .	1 1 0
Berwickshire Naturalists' Club, Do. . . . .	0 10 0
Paleontographical Society, Do. . . . .	1 1 0
History of Science Society, Do. . . . .	1 1 0
Edinburgh and Leith Post-Office Directory, Ltd. . . . .	0 13 6
Institution of Civil Engineers, for Abstracts . . . . .	0 10 0
Bombay Natural History Society, for <i>Journal</i> . . . . .	2 1 0
Scientific and Learned Societies' Year Book 1930 . . . . .	0 15 6
Dowell's Ltd., for 4 volumes "Scottish Naturalist" . . . . .	0 8 0
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	322 10 5

Carry forward . . . . .

£2306 2 3  
24

	Brought forward	£2306 2 3
<b>5. OTHER PAYMENTS:—</b>		
Neill & Co., Ltd., Printers . . . . .	£130 13 7	
A. Cowan & Sons, Ltd. . . . .	16 15 6	
S. Duncan & Sons, Tailors (uniform) . . . . .	9 9 0	
Macvitties, Guest & Co., Ltd. . . . .	55 17 0	
Andrew H. Baird . . . . .	11 8 0	
Lindsay, Jamieson & Haldane, C.A., Auditors . . . . .	10 10 0	
The Window Cleaning Co., Ltd. . . . .	16 18 0	
*Orrock & Son, Ltd., Bookbinders . . . . .	200 4 3	
Federated Superannuation System for Universities . . . . .	5 0 0	
G. Waterston & Sons, Ltd. . . . .	12 6 7	
Telephone Accounts . . . . .	13 17 3	
G. Cairns, Plumber . . . . .	30 18 0	
W. S. Brown & Sons, Upholsterers, etc. . . . .	9 12 0	
Regants, Ltd., Electric Fittings . . . . .	33 9 3	
Edward & Co., Electrical Repairs . . . . .	12 0 2	
Miscellaneous Accounts under £5 . . . . .	33 4 8	
Charwoman . . . . .	63 14 0	
Petty Expenses, Postages, Carriage, etc. . . . .	62 19 0	
	<u>£728 16 3</u>	
*Less—Bequest from the late Charles du Riche-Preller for Library or Publication purposes as in last session's Accounts . . . . .	100 0 0	
		<u>628 16 3</u>
<b>6. CONT OF SHELVING IN LIBRARY:—</b>		
Balance carried forward from previous session . . . . .	£100 0 0	
Work on Shelving incurred this year . . . . .	132 17 6	
	<u>£232 17 6</u>	
Less—Books, etc., sold . . . . .	145 18 0	
Balance . . . . .		<u>86 19 6</u>
<b>7. ARREARS OF CONTRIBUTIONS outstanding at 30th September 1930:—</b>		
Present Session . . . . .	£53 11 0	
Previous Sessions . . . . .	18 18 0	
	<u>72 9 0</u>	
Amount of the Discharge . . . . .		<u>£3094 7 0</u>
Amount of the Charge . . . . .		<u>£3109 18 6</u>
Amount of the Discharge . . . . .		<u>3094 7 0</u>
Excess of Charge transferred to Special Subscription Fund . . . . .		<u>£15 11 6</u>

## SPECIAL SUBSCRIPTION FUND

To 30th September 1930.

CHARGE.		
Total Subscriptions towards Fund . . . . .		<u>£1128 17 9</u>
DISCHARGE.		
1. Sum required to write War Loan Investment down to par . . . . .		£7 12 0
2. Transfers to General Fund to meet Deficits—		
Up to 30th September 1929 . . . . .	£347 3 1	
Less—Surplus to 30th September 1930 . . . . .	15 11 6	
	<u>331 11 7</u>	
3. BALANCE OF FUND—		
£751, 16s. 5% War Loan, 1929–47, at par . . . . .	£751 16 0	
Due by Treasurer . . . . .	9 18 7	
Due by Union Bank of Scotland, Ltd., on Current Account . . . . .	27 19 7	
	<u>789 14 2</u>	
		<u>£1128 17 9</u>

# Abstract of Accounts.

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## II. KEITH FUND

To 30th September 1930.

### CHARGE.

1. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1929 . . . . .	£74 8 8
2. INTEREST RECEIVED:—	
On £650 5% War Loan, 1929-47, Untaxed . . . . .	£32 10 0
On Deposit Receipts . . . . .	1 16 1
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	34 0 1
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	£108 14 9

### DISCHARGE.

1. Alex. Kirkwood & Son, for Gold Medal . . . . .	£18 0 0
Dr Christina C. Miller, Money Portion of Prize, 1927-29 . . . . .	47 0 0
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	£65 0 0
2. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	43 14 9
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	£108 14 9

## III. NEILL FUND

To 30th September 1930.

### CHARGE.

1. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1929 . . . . .	£33 8 3
2. INTEREST RECEIVED:—	
On £300 5% War Loan, 1929-47, Untaxed . . . . .	£15 0 0
On Deposit Receipts . . . . .	0 15 7
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	15 15 7
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	£49 3 10

### DISCHARGE.

1. Alex. Kirkwood & Son, for Gold Medal . . . . .	£18 0 0
Prof. E. B. Bailey, Money Portion of Prize, 1927-29 . . . . .	12 0 0
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	£30 0 0
2. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	19 3 10
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	£49 3 10

## IV. MAKDOUGALL-BRISBANE FUND

To 30th September 1930.

### CHARGE.

1. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1929 . . . . .	£48 17 10
2. INTEREST RECEIVED:—	
On £400 5% War Loan, 1929-47, Untaxed . . . . .	£20 0 0
On Deposit Receipts . . . . .	1 6 2
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	21 6 2
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	£70 4 0

### DISCHARGE.

BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	£70 4 0
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**V. MAKERSTOUN MAGNETIC METEOROLOGICAL OBSERVATION FUND***To 30th September 1930.***CHARGE.**

1. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1929 . . . . .	£50 16 9
2. INTEREST RECEIVED:—	
On £250 5% War Loan, 1929-47, Untaxed . . . . .	£12 10 0
On Deposit Receipts . . . . .	1 5 7
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	13 15 7
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	£64 12 4

**DISCHARGE.**

BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	£64 12 4
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**VI. GUNNING VICTORIA JUBILEE PRIZE FUND***To 30th September 1930.***CHARGE.**

1. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1929 . . . . .	£69 1 1
2. INTEREST RECEIVED:—	
On £599, 14s. 5% War Loan, 1929-47, Untaxed . . . . .	£29 19 8
On Deposit Receipts . . . . .	1 17 8
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	81 17 4
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	£100 18 5

**DISCHARGE.**

BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	£100 18 5
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**VII. JAMES SCOTT PRIZE FUND***To 30th September 1930.***CHARGE.**

1. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1929 . . . . .	£29 18 10
2. INTEREST RECEIVED:—	
On £247, 10s. 5% War Loan, 1929-47, Untaxed . . . . .	£12 7 6
On Deposit Receipts . . . . .	0 11 6
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	12 19 0
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	£42 17 10

**DISCHARGE.**

1. Prof. Neils Bohr, Money Prize, 1927-30 . . . . .	£40 0 0
2. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	2 17 10
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	£42 17 10

**VIII. PUBLICATION FUND**

(COMPRISING PETER GUTHRIE TAIT MEMORIAL FUND AND DR JOHN AITKEN FUND)

*To 30th September 1930.***CHARGE.**

1. PETER GUTHRIE TAIT MEMORIAL FUND:—		
Year's Interest on £1550 5% War Loan, 1929-47, Untaxed . . . . .	£77 10 0	
2. DR JOHN AITKEN FUND:—		
Year's Interest on £445, 10s. 5% War Loan, 1929-47, Untaxed, . . . . .	£22 5 6	
Interest on Deposit Receipts . . . . .	1 18 3	
Sale of Volumes . . . . .	0 17 6	
	<hr/>	25 1 3
		<hr/>
		£102 11 3

**DISCHARGE.**

Paid to General Fund to meet Cost of Publications (see General Fund Discharge, No. 2) . . . . .	£102 11 3
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**IX. DR W. S. BRUCE MEMORIAL FUND***To 30th September 1930.***CHARGE.**

1. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1929 . . . . .	£10 3 3	
2. INTEREST RECEIVED:—		
On £238 3¼% Conversion Loan, 1961 . . . . .	£8 3 0	
On Deposit Receipts . . . . .	0 3 11	
	<hr/>	8 6 11
		<hr/>
		£18 10 2

**DISCHARGE.**

1. Alex. Kirkwood & Son, for Medal . . . . .	£0 15 0
N. A. Mackintosh, Money Portion of Prize . . . . .	10 0 0
	<hr/>
	£10 15 0
2. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	7 15 2
	<hr/>
	£18 10 2

**X. BRUCE-PRELLER LECTURE FUND***To 30th September 1930.***CHARGE.**

1. BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1929 . . . . .	£9 11 0	
2. DIVIDEND RECEIVED:—		
On £140, 9s. Royal Bank of Scotland Stock, less Tax £5, 1s. 6d. . . . .	£18 16 0	
On Deposit Receipts . . . . .	0 7 1	
	<hr/>	19 3 1
3. Income Tax reclaimed, Year to 5th April 1930 . . . . .	4 15 6	
	<hr/>	£33 9 7

**DISCHARGE.**

BALANCE due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	£33 9 7
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**XI. DR DAVID ANDERSON-BERRY FUND***To 30th September 1930.***CHARGE.**

Interest on Deposit Receipt of £1000 left as permanent bequest . . . . .	£5 1 8
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**DISCHARGE.**

Balance of Revenue due by Union Bank of Scotland, Ltd., on Deposit Receipt at 30th September 1930 . . . . .	£5 1 8
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**STATE OF THE FUNDS BELONGING TO THE ROYAL  
SOCIETY OF EDINBURGH***As at 30th September 1930.***1. GENERAL FUND—**

1. £7880 5% War Loan, 1929-47 . . . . .	£7880 0 0
2. £2100 2½% Consolidated Stock at 53% . . . . .	1118 0 0
3. £445, 10s. 5% War Loan, 1929-47. Mr Robert Mackay Smith, Legacy . . . . .	445 10 0
4. Arrears of Contributions, as per preceding Abstract of Accounts . . . . .	72 9 0
5. Balance of Special Subscription Fund—	
£751, 16s. 5% War Loan, 1929-47 . . . . .	£751 16 0
Cash due by Treasurer . . . . .	9 18 7
Cash due by Union Bank of Scotland, Ltd., on Current Account . . . . .	27 19 7
	789 14 2
AMOUNT . . . . .	£10,250 18 2

Exclusive of Library, Museum, Pictures, etc., and Furniture in the Society's Rooms  
at George Street, Edinburgh.

**2. KEITH FUND—**

1. £650 5% War Loan, 1929-47 . . . . .	£650 0 0
2. Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	43 14 9
AMOUNT . . . . .	£693 14 9

**3. NEILL FUND—**

1. £300 5% War Loan, 1929-47 . . . . .	£300 0 0
2. Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	19 3 10
AMOUNT . . . . .	£319 3 10

**4. MAKDOUGALL-BRISBANE FUND—**

1. £400 5% War Loan, 1929-47 . . . . .	£400 0 0
2. Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	70 4 0
AMOUNT . . . . .	£470 4 0

**5. MAKERSTOUN MAGNETIC METEOROLOGICAL OBSERVATION FUND—**

1. £250 5% War Loan, 1929-47 . . . . .	£250 0 0
2. Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	64 12 4
AMOUNT . . . . .	£314 12 4

**6. GUNNING VICTORIA JUBILEE PRIZE FUND—**Instituted by Dr Gunning of Edinburgh and Rio de Janeiro—

1. £599, 14s. 5% War Loan, 1929-47 . . . . .	£599 14 0
2. Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	100 18 5
AMOUNT . . . . .	<u>£700 12 5</u>

**7. JAMES SCOTT PRIZE FUND—**

1. £247, 10s. 5% War Loan, 1929-47 . . . . .	£247 10 0
2. Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	2 17 10
AMOUNT . . . . .	<u>£250 7 10</u>

**8. PUBLICATION FUND—**

(COMPRISING PETER GUTHRIE TAIT MEMORIAL FUND AND DR JOHN AITKEN FUND)

**1. PETER GUTHRIE TAIT MEMORIAL FUND:—**

£1550 5% War Loan, 1929-47 . . . . .	£1550 0 0
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**2. DR JOHN AITKEN FUND:—**

£445, 10s. 5% War Loan, 1929-47 . . . . .	£445 10 0
Deposit Receipt with Union Bank of Scotland, Ltd. . . . .	71 6 1
	<u>516 16 1</u>

AMOUNT . . . . .	<u>£2066 16 1</u>
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**9. DR W. S. BRUCE MEMORIAL FUND—**

1. £283 8½% Conversion Loan, at 72½% . . . . .	£169 15 11
2. Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	7 15 2
AMOUNT . . . . .	<u>£177 11 1</u>

**10. BRUCE-PRELLER LECTURE FUND—**

1. £140, 9s. Royal Bank of Scotland Stock, at 850% . . . . .	£491 11 6
2. Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	33 9 7
AMOUNT . . . . .	<u>£525 1 1</u>

**11. DR DAVID ANDERSON-BERRY FUND—**

Balance due by Union Bank of Scotland, Ltd., on Deposit Receipt . . . . .	<u>£1005 1 8</u>
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*Note.*—5% War Stock 1929-47 has been valued at par in the above State of Funds.

EDINBURGH, 17th October 1930.—We have examined the preceding Accounts of the Treasurer of the Royal Society of Edinburgh for the Session 1929-1930, and have found them to be correct. The securities for the various Investments, as noted in the foregoing Statement of Funds, have been verified by us as at 30th September 1930.

LINDSAY, JAMIESON & HALDANE, C.A.,

*Auditors.*

**LIST OF VOLUNTARY CONTRIBUTORS who have made a  
Single Payment under Law VI (end of para. 3), up to 30th  
September 1930.**

Professor J. H. M. WEDDERBURN, . . . . £10 10 0

**LIST OF VOLUNTARY CONTRIBUTORS under Law VI  
(end of para. 3), up to 30th September 1930.**

				Carried forward . . . . .	£21 0 0
Col. A. F. APPLETON, . . . . .	£1	1	0	F. H. LIGHTBODY, Esq., . . . . .	1 1 0
Sir JAMES BARR, . . . . .	1	1	0	Dr P. M'BRIDE, . . . . .	1 1 0
Sir T. HUDSON BEARE, . . . . .	1	1	0	JAMES A. MACDONALD, Esq., . . . . .	1 1 0
Em. Professor F. O. BOWER, F.R.S., . . . . .	1	1	0	Dr GEORGE M'GOWAN, . . . . .	1 1 0
His Hon. Judge F. E. BRADLEY, . . . . .	1	1	0	Lt.-Col. A. G. MCKENDRICK, . . . . .	1 1 0
Sir BYROM BRAMWELL, . . . . .	1	1	0	Dr D. J. MACKINTOSH, . . . . .	1 1 0
Dr G. S. BROCK, . . . . .	1	1	0	R. C. MOSSMAN, Esq., . . . . .	2 2 0
J. W. BUTTERS, Esq., . . . . .	1	1	0	Sir THOMAS MUIR, F.R.S., . . . . .	1 1 0
Col. DAVID CARNEGIE, . . . . .	1	1	0	Professor WM. PIEDIE, . . . . .	1 1 0
Professor E. G. COKER, F.R.S., . . . . .	1	1	0	Em. Professor A. G. PERKIN, F.R.S., . . . . .	1 1 0
DAVID CORRIE, Esq., . . . . .	1	1	0	Dr PETER PINKERTON, . . . . .	1 1 0
Dr JAMES CURRIE, . . . . .	1	1	0	A. G. RAMAGE, Esq., . . . . .	1 1 0
Dr JOHN EDWARDS, . . . . .	1	1	0	RALPH RICHARDSON, W.S., . . . . .	1 1 0
Dr WM. ELDER, . . . . .	1	1	0	Professor R. A. ROBERTSON, . . . . .	1 1 0
Dr J. HAIG FERGUSON, . . . . .	1	1	0	JAMES RUSSELL, Esq., . . . . .	2 2 0
J. S. FORD, Esq., . . . . .	1	1	0	EDWARD SMART, Esq., . . . . .	1 1 0
Rev. Dr G. A. FRANK KNIGHT, . . . . .	1	1	0	JOHN W. TAIT, Esq., . . . . .	1 1 0
Dr J. FLETCHER HORNE, . . . . .	1	1	0	Professor Sir J. ARTHUR THOMSON, . . . . .	1 1 0
Dr E. M. HORSBURGH, . . . . .	1	1	0	Dr A. LOGAN TURNER, . . . . .	3 8 0
Dr W. F. HUME, . . . . .	1	1	0	J. C. WRIGHT, Esq., . . . . .	1 1 0
	£21	0	0	Total, . . . . .	<u>£46 4 0</u>

Single payments, . . . . .	£10 10 0
Other payments, . . . . .	46 4 0
<b>Total, . . . . .</b>	<b><u>£56 14 0</u></b>

## THE COUNCIL OF THE SOCIETY.

27th October 1930.

### PRESIDENT.

PROFESSOR SIR E. A. SHARPEY-SCHAFER, M.D., D.Sc., LL.D., F.R.S.

### VICE-PRESIDENTS.

PROFESSOR J. GRAHAM KERR, M.A., F.R.S., F.L.S.

PROFESSOR W. WRIGHT SMITH, M.A.

PROFESSOR FRANCIS G. BAILY, M.A., M.Inst.E.E.

PROFESSOR T. J. JEHU, M.A., M.D., F.G.S.

PROFESSOR J. H. ASHWORTH, D.Sc., F.R.S.

ARTHUR LOGAN TURNER, M.D., LL.D., F.R.C.S.E.

### GENERAL SECRETARY.

PROFESSOR R. A. SAMPSON, M.A., D.Sc., LL.D., F.R.S.

### SECRETARIES TO ORDINARY MEETINGS.

PROFESSOR C. G. DARWIN, M.A., F.R.S.

PROFESSOR JAMES RITCHIE, M.A., D.Sc.

### TREASURER.

JAMES WATT, W.S., LL.D.

### CURATOR OF LIBRARY AND MUSEUM.

PROFESSOR D'ARCY W. THOMPSON, C.B., F.R.S.

### COUNCILLORS.

J. B. CLARK, M.A., LL.D., J.P.

PROFESSOR F. A. E. CREW, M.D., Ch.B.,  
D.Sc., Ph.D.

PROFESSOR J. MONTAGU F. DRUMMOND,  
M.A.

DAVID ALAN STEVENSON, B.Sc., M.Inst.  
C.E.

PROFESSOR H. W. TURNBULL, M.A.

SIR JAMES WALKER, Kt., D.Sc., LL.D.,  
F.R.S.

JAMES DREVER, M.A., B.Sc., D.Phil.

A. H. R. GOLDIE, M.A., B.A.

ROBERT ALEX. HOUSTOUN, M.A., Ph.D.,  
D.Sc.

THE HON. LORD SANDS, Kt., K.C., LL.D.,  
D.D.

MURRAY MACGREGOR, M.A., B.Sc.

A. CRICHTON MITCHELL, D.Sc.

### OFFICE STAFF.

*Assistant Secretary and Librarian*, G. A. STEWART.

*Assistant Librarian*, R. J. B. MUNRO.

*Housekeeper*, SAMUEL HEDDLE.

# ALPHABETICAL LIST OF THE ORDINARY FELLOWS OF THE SOCIETY,

Corrected to 27th October, 1930.

N.B.—Those marked \* are Annual Contributors.

“ ” + have commuted Voluntary Contribution (see 3rd Paragraph, Law VI).

M.B. prefixed to a name indicates that the Fellow has received a Makdougall-Brisbane Medal.

K. “ “ “ “ Keith Medal.

N. “ “ “ “ Neill Medal.

V. J. “ “ “ “ the Gunning Victoria Jubilee Prize.

C. “ “ “ “ has contributed one or more Communications to the Society's TRANSACTIONS or PROCEEDINGS.

B. “ “ “ “ has received a Bruce Medal.

Date of Election.			Service on Council, etc.
1922		* Abernethy, Charles Lawrence, M.A. (Hons.), B.Sc., Research Physicist, "Exnabie," Craiglockhart Avenue, Slateford, Edinburgh	
1925	C.	* Aitken, Alexander Craig, M.A., D.Sc., Lecturer in Mathematics in the University of Edinburgh. Mathematical Institute, 16 Chambers Street, Edinburgh	
1889		† Alison, John, M.A., LL.D., formerly Head Master, George Watson's College, 126 Craiglea Drive, Edinburgh	
1927	C.	* Allan, Douglas Alexander, Ph.D. (Edin.), D.Sc., Director, City of Liverpool Public Museums, William Brown Street, Liverpool	
1894		† Allan, Francis John, M.D., C.M. (Edin.), M.O.H. City of Westminster. Includen, 33 Cromwell Road, Teddington, Middlesex	
1920	C.	* Allen, Herbert Stanley, M.A. (Cambridge), D.Sc. (London), F.R.S., Professor of Natural Philosophy in the University of St Andrews	1921-24.
1920	M.B. C.	* Anderson, Ernest Masson, M.A., B.Sc., F.G.S., 50 Greenbank Crescent, Edinburgh	
1905		Anderson, William, M.A., Head Science Master, George Watson's College, Edinburgh. 6 Lockharton Crescent, Edinburgh	
1905		Andrew, George, M.A., B.A., H.M.I.S., Royal Technical College, George Street, Glasgow. Hamewith, Kilmacolm, Renfrewshire	
1881	C.	Anglin, Arthur H., M.A., LL.D., M.R.I.A., formerly Professor of Mathematics, Queen's College, Cork	
1930		* Annan, William, M.A., C.A., F.C.W.A., Professor of Accounting and Business Method in the University of Edinburgh. Tofthill, Ferry Road West, Edinburgh	
1915		Anthony, Charles, M.Inst.C.E., M.Am.Soc.C.E., F.R.San.I., F.R.Met.S., F.R.A.S., F.C.S., c/o Royal Society, Edinburgh	
1906		Appleton, Colonel Arthur Frederick, F.R.C.V.S., Nutwell, 34 Shortlands Road, Shortlands, Kent	
1910	C.	Archibald, E. H., B.Sc., Professor of Chemistry, University of British Columbia, Vancouver, Canada	
1921		* Arthur, William, M.A., Lecturer in Mathematics in the University of Glasgow. 148 Carmunnock Road, Cathcart, Glasgow	
1911	C. K.	* Ashworth, James Hartley, D.Sc., F.R.S. (VICE-PRESIDENT), Professor of Natural History, University of Edinburgh. "Hillbank," Grange Loan, Edinburgh	1912-14, 1915-18, 1927-30. Sec. 1918-23. V.P. 1923-26, 1930-
1920		* Bagnall, Richard Siddoway, Hon. D.Sc., Member of the Entomological and other Scientific Societies. 9 Manor Place, Edinburgh	
1920	C. N.	* Bailey, Edward Batterby, M.C., M.A., F.R.S., F.G.S., Professor of Geology in the University of Glasgow	

# Alphabetical List of the Ordinary Fellows of the Society. 379

Date of Election.			Service on Council, etc.
1896	C.	† Baily, Francis Gibson, M.A., M.Inst.E.E. (VICE-PRESIDENT), Professor of Electrical Engineering, Heriot-Watt College, Edinburgh. Newbury, Colinton, Midlothian	1909-12, 1920-28, V.P. 1929-
1921		* Baker, Bevan Braithwaite, M.A., D.Sc., Professor of Mathematics, Royal Holloway College, Englefield Green, London	
1928	C.	* Baker, Edwin Arthur, D.Sc. (Edin.), Assistant at the Royal Observatory, Edinburgh. 17 Ladysmith Road, Edinburgh	
1905	C.	Balfour-Browne, William Alexander Francis, M.A., F.Z.S., F.E.S., Barrister-at-Law, late Professor of Entomology at the Imperial College of Science and Technology, South Kensington, London, S.W. 7. Winscombe Court, Winscombe, Somerset	
1923		* Bannerman, David Armitage, M.A. (Cantab.), M.B.E., M.A., F.R.G.S., Special Assistant (Ornithology) in the Department of Zoology, British Museum (Natural History), London. 7 Pembroke Gardens, Kensington, London, W. 8	
1928		* Barbour, George Brown, M.A. (Edin.), M.A. (Camb.), Ph.D., Professor of Geology, Yenching University, Peiping (Pekin), China (via Siberia)	
1886		Barclay, A. J. Gunion, M.A., 3 Chandos Avenue, Oakleigh Park, London, N.	
1903		Bardwell, Noel Dean, M.V.O., M.D., M.R.C.P. (Ed. and Lond.), New County Hall, Westminster Bridge Road, London, S.E. 1	
1922		* Barger, George, M.A., D.Sc., Dr h. c. (Padua), Hon. D.Sc. (Liverp.), F.R.S., Hon. Mem. Nederl. Chem. Vereen; Corr. Mem. Bayerische Akad. d. Wissensch. München and Ges. d. Wissensch. Göttingen, Professor of Chemistry (Medical) in the University of Edinburgh. 48 St Alban's Road, Edinburgh	1925-28.
1929		* Barker, Sydney George, Ph.D., D.I.C., F.Inst.P., Director of Research, British Research Association for the Woollen and Worsted Industries. Torridon, Headingley, Leeds	
1914	C.	* Barkla, Charles Glover, M.A., D.Sc., F.R.S., Professor of Natural Philosophy in the University of Edinburgh, Nobel Laureate, Physics, 1917. The Hermitage of Braid, Edinburgh	1915-18, 1924-27.
1926		* Barlow, Thomas William Naylor, O.B.E., M.R.C.S., D.P.H., Barrister-at-Law, Past President of the Incorporated Society of Medical Officers of Health. 23 North Drive, New Brighton, Cheshire	
1927		* Barnett, John, F.F.A., C.A., Scottish Widows' Fund Life Assurance Society, 9 St Andrew Square, Edinburgh	
1921		* Barr, Archibald, D.Sc., LL.D., F.R.S. (Glasgow and Birmingham), Em. Professor of Engineering in the University of Glasgow. Westerton of Mugdock, Milngavie	
1904		Barr, Sir James, C.B.E., M.D., LL.D., F.R.C.P. (Lond.), Hindhead Brae, Hindhead, Surrey	
1921		* Bartholomew, John, M.C., M.A., F.R.G.S., Geographical Institute, Duncan Street, Edinburgh. Nairne Lodge, Duddingston	1925-28.
1927		* Bastow, Stephen Everard, M.Inst.E.E., M.Inst.Min.E., Managing Director, Bruce Peebles & Co., Ltd., Edinburgh. Northwood, Russell Place, Trinity, Edinburgh	
1929		* Bath, Frederick, B.Sc., Ph.D., Lecturer in Mathematics, University of St Andrews, Assistant to the Professor of Mathematics, University College, Dundee	
1918		† Beard, Joseph, F.R.C.S. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Camb.), Medical Officer of Health and School Medical Officer, City of Carlisle. 8 Carlton Gardens, Carlisle	
1888		Beare, Sir Thomas Hudson, B.A., B.Sc., M.Inst.C.E., J.P., D.L., Professor of Engineering in the University of Edinburgh	1907-09. V.P. 1909-15, 1923-26.
1897	C.	Beattie, Sir John Carruthers, K.B., D.Sc., LL.D., Vice-Chancellor and Principal, The University, Cape Town	
1898	C.	Becker, Ludwig, Ph.D., Regius Professor of Astronomy in the University of Glasgow. The Observatory, Dowanhill, Glasgow	
1916	M.R.	* Bell, Robert John Tainsh, M.A., D.Sc., Professor of Mathematics in the University of Otago, Dunedin, New Zealand	
1915		Bell, Walter Leonard, M.D. (Edin.), F.S.A.Scot., Langarth, Brisco, Carlisle	
1929		* Bennet, George, B.Sc., A.M.I.Mech.E., Lecturer in Mechanical Engineering, 68 Arden Street, Edinburgh	
1893	O.	Berry, Sir George A., M.B., C.M., LL.D., F.R.C.S.E., M.P., King's Knoll, North Berwick	1916-19. V.P. 1919-22.



Date of Election.			Service on Council, etc.
1897	C.	Berry, Richard J. A., M.D., F.R.C.S.E., Professor of Anatomy in the University of Melbourne, Victoria, Australia	
1880	C.	Birch, de Burgh, C.B., M.D., Em. Professor of Physiology in the University of Leeds	
1907		* Black, Frederick Alexander, Solicitor, 57 Academy Street, Inverness	
1918		* Blight, Francis James, formerly Chairman and Managing Director of Charles Griffin & Co., Ltd., Publishers, Belstone Tor, Uphill Road, Mill Hill, London, N.W. 7	
1894		Bolton, Herbert, D.Sc., F.G.S., F.Z.S., lately Director of the Bristol Museum and Art Gallery, Bristol. 58 Coldharbour Road, Redland, Bristol	
1915		* Boon, Alfred Archibald, D.Sc., B.A., F.I.C., Professor of Chemistry, Heriot-Watt College, Edinburgh	
1925		* Borthwick, Albert William, O.B.E., D.Sc., Professor of Forestry in the University of Aberdeen	
1925		* Bose, Sahay Ram, M.A., D.Sc., F.L.S., Professor of Botany in the Carmichael Medical College, Belgachia, Calcutta, India	
1886	C. N.	Bower, Frederick Orpen, M.A., D.Sc., LL.D., F.R.S., F.L.S., Em. Regius Professor of Botany in the University of Glasgow. 2 The Crescent, Ripon, Yorks	1887-90, 1898-96, 1907-09, 1917-19, V.P. 1910-16. P 1919-24.
1924		* Bowman, Alexander, D.Sc., Scientific Superintendent, Marine Laboratory, Fishery Board for Scotland, Torry, Aberdeen	
1916		Bradley, His Honour Judge (Francis Ernest), M.A., M.Com., LL.D., Member of the Court of Governors of Manchester University. 8 Balmoral Road, St Annes-on-the-Sea	
1903	C.	Bradley, O. Charnock, M.D., D.Sc., Principal, Royal (Dick) Veterinary College, Edinburgh	1907-10, 1915-17.
1926		* Braid, Kenneth William, B.A. (Cantab.), B.Sc., Professor of Botany, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow	
1886		Bramwell, Sir Byrom, M.D., F.R.C.P.E., F.R.C.P. (Lond.), LL.D., D.C.L., 10 Heriot Row, Edinburgh	1890-98.
1907		* Bramwell, Edwin, Professor of Clinical Medicine in the University of Edinburgh, M.D., F.R.C.P.E., F.R.C.P. (Lond.). 23 Drumsheugh Gardens, Edinburgh	
1918		* Brenner, Alexander, M.A., D.Sc., Headmaster, Demonstration School, Training Centre, Aberdeen. 13 Belgrave Terrace, Aberdeen	
1916	C.	* Briggs, Henry, O.B.E., D.Sc., Ph.D., A.R.S.M., James A. Hood Professor of Mining in the University of Edinburgh. 12 Gordon Terrace, Edinburgh	1923-26.
1895		Bright, Sir Charles, M.Inst.C.E., M.Inst.E.E., F.R.A.S., F.Inst.Radio.E., F.R.A.S., F.R.G.S., Little Brewers', Hatfield Heath, Harlow, Essex, and Athenaeum Club, Pall Mall, London, S.W.	
1893		Brook, G. Sandison, M.D., F.R.C.P.E., 53 Chemiston Gardens, Kensington, London, W. 8	
1901	C.	Brodie, W. Brodie, M.D., Camden House, Bletchingley, Surrey	
1907		Brown, Alexander, M.A., B.Sc., Professor of Applied Mathematics, The University, Cape Town	
1928		* Brown, Hugh Wylie, F.I.A., F.F.A., 1 Cobden Crescent, Edinburgh	
1885	C.	Brown, J. Macdonald, M.D., F.R.C.S., Redcot, Shirburn Road, Torquay	
1924		* Brown, Thomas Arnold, M.A., B.Sc., Professor of Mathematics in University College, Exeter	
1928		* Brown, Walter, M.A., B.Sc., Professor of Mathematics, The University, Hong Kong, China	
1921		* Bruce, Alexander, B.Sc. (Edin.), Government Agricultural Chemist and City Analyst, The Laboratory, Turret Road S., Colombo, Ceylon	
1912		* Bruce, Alexander Ninian, D.Sc., M.D., 8 Ainalie Place, Edinburgh	
1927		* Bryce, David Lawrence, Student of Micro-Zoology. Vice-President (1918-1925), Quakett Microscopical Club. Salfords Parsonage, Horley, Surrey	
1898	C. K.	† Bryce, Thomas Hastie, M.A., M.D. (Edin.), F.R.S., Professor of Anatomy in the University of Glasgow. 2 The College, Glasgow	1911-14, 1922-25. V.P. 1925-28.
1902		Burgess, A. G., M.A., D.Sc., Rector of The Academy, Rothesay. Blythswood, Rothesay	

# Alphabetical List of the Ordinary Fellows of the Society. 381

Date of Election.			Service on Council, etc.
1887		* Burnet, Sir John James, R.A., R.S.A., LL.D., Architect, Killermont, Rowledge, Farnham, Surrey	
1888		Burns, Rev. Thomas, C.B.E., D.D., J.P., F.S.A.Scot., Minister of Lady Glenorohy's Parish Church, Croston Lodge, Chalmers Crescent, Edinburgh	
1917		* Burnside, George Barnhill, M.I. Mech.E., 104 Beechwood Drive, Glasgow, W.	
1980	C.	* Burt, David Raitt Robertson, B.Sc. (St Andrews), F.L.S., Lecturer in Zoology, Ceylon University College, Colombo. Fernbank, Kirkcaldy	
1915		* Butchart, Raymond Keller, B.Sc., Ph.D., Professor of Mathematics, Raffles College, Singapore	
1896		Butters, John W., M.A., B.Sc., formerly Rector of Ardrossan Academy. 116 Comiston Drive, Edinburgh	
1887	C.	Cadell, Henry Monbray, of Grange, B.Sc., M.Inst.M.E., D.L., Linlithgow	1919-22.
1929	C.	* Calder, Alexander, B.Sc., Ph.D., Assistant in the Animal Breeding Research Department, The University, Edinburgh	
1910		* Calderwood, Rev. Robert Sibbald, D.D., Minister of Cambuslang, The Old Manse, Cambuslang, Lanarkshire	
1893	C.	Calderwood, W. L., L.S.O., formerly Inspector of Salmon Fisheries of Scotland, Canaan Grove, 82 Newbattle Terrace, Edinburgh	1923-26.
1926	C.	* Cameron, Alfred E. Henderson, M.A., D.Sc. (Aberd.), M.Sc. (Vict.), Lecturer in Entomology, Zoology Department, The University, Edinburgh. 8 West Savile Road, Edinburgh	
1905	C.	Cameron, John, M.D., D.Sc., M.R.C.S.Eng., formerly Professor of Anatomy, Dalhousie University, Halifax, Nova Scotia. Wingfield, Grosvenor Gardens, Golders Green, London, N.W. 11	
1921		* Campbell, Andrew, Advisory Chemist, Burmah Oil Co., Ltd., and Anglo-Persian Oil Co., Ltd. 36 Abbey Lodge, Hanover Gate, Regent's Park, London, N.W.	
1918		* Campbell, John Menzies, L.D.S. (Glas.), D.D.S. (Toronto), L.D.S. (Ontario), F.I.C.D., 14 Buckingham Terrace, Glasgow, W.	
1915	C. N.	* Campbell, Robert, M.A., D.Sc., F.G.S., Lecturer in Petrology, University of Edinburgh. Maryton, Colinton	1920-23.
1927	C.	* Cannon, Herbert Graham, M.A., Sc.D. (Cantab.), D.Sc. (Lond.), F.L.S., Professor of Zoology in the University of Sheffield	
1899	C.	Carlier, Edmund W. W., B. ès Sc. (France), M.Sc., M.D., F.E.S., Em. Professor of Physiology, University, Birmingham. Morningside, Dorridge, near Birmingham	
1910		Carnegie, Col. David, C.B.E., M.Inst.C.E., M.Inst.Mech.E., M.I.S.Inst., Haven, Seasalter, Whitstable	
1920	C.	* Carruthers, R. G., F.G.S., District Geologist, H.M. Geological Survey, High Barn, Stocksfield-on-Tyne	
1905	C.	Carse, George Alexander, M.A., D.Sc., Reader in Natural Philosophy, University of Edinburgh. 3 Middleby Street, Edinburgh	
1901		Carslaw, Horatio Scott, M.A., Sc.D. (Camb.), D.Sc., LL.D. (Glas.), Fellow of Emmanuel College, Cambridge, Professor of Mathematics in the University of Sydney, New South Wales	
1925		* Carter, George Stuart, M.A., Ph.D., Corpus Christi College, Cambridge	
1898		Carus-Wilson, Cecil, J.P., F.R.G.S., F.G.S., Mayor of Twickenham, 16 Waldegrave Park, Strawberry Hill, Middlesex, and Sandacres Lodge, Parkstone-on-Sea, Dorset	
1899		Chatham, James, Actuary, c/o Robert Murrie, Esq., 43 Morningside Park, Edinburgh	
1912		Chaudhuri, Banawari Lal, B.A. (Cal.), D.Sc. (Edin.), formerly Superintendent, Natural History Section, Indian Museum, Shergarhpur P. O., India	
1925	C.	* Chumley, James, M.A., Ph.D., Lecturer on Oceanography, Department of Zoology, University of Glasgow. Thalassa, Thorn Drive, Bearaden, Dumblartonshire	
1928	C.	* Clark, Alfred Joseph, B.A., M.D., Professor of Materia Medica in the University of Edinburgh. 67 Braid Avenue, Edinburgh	1928-
1891		Clark, John Brown, M.A., LL.D., J.P., formerly Head Master of George Heriot's School. Garleffin, 146 Craiglea Drive, Edinburgh	
1911		* Clark, William Inglis, D.Sc., 1 Belgrave Crescent, Edinburgh	
1908		Clarke, William Eagle, I.S.O., LL.D., F.L.S., Honorary Supervisor of the Bird Collection and formerly Keeper of the Natural History Collections in the Royal Scottish Museum, Edinburgh. 8 Grosvenor Street, Edinburgh	
1909		Clayton, Thomas Morrison, M.D., D.Hy., B.Sc., D.P.H., Medical Officer of Health, Gateshead, Health Department, Greenesfield House, Gateshead-on-Tyne	
1922		* Clerk, Sir Dugald, K.B.E., D.Sc., LL.D., F.R.S., M.Inst.C.E., etc., Lukyns, Ewhurst, Surrey	

Date of Election.			Service on Council, etc.
1904	C.	Coker, Ernest George, M.A. (Cantab.), D.Sc. (Edin.), Hon. D.Sc. (Sydney and Louvain), M.Sc. (M'Gill), F.R.S., M.Inst.C.E., M.I.Mech.E., Kennedy Professor of Civil and Mechanical Engineering, and Director of the Engineering Laboratories, University of London, University College, Gower Street, London, W.C. 1	
1904		Coles, Alfred Charles, M.D., D.Sc., York House, Poole Road, Bournemouth, W.	
1888	V. J.	Collie, John Norman, Ph.D., D.Sc., LL.D., F.R.S., F.C.S., F.I.C., F.R.G.S., Em.	
	C.	Professor of Organic Chemistry in the University College, Gower Street, London	
1909	C.	* Comrie, Peter, M.A., B.Sc., LL.D., Rector, Leith Academy. 19 Craighouse Terrace, Edinburgh	
1924	C.	* Copson, Edward Thomas, M.A., D.Sc., Lecturer in Applied Mathematics in the University of St Andrews. St Salvator's Hall, St Andrews	
1929		* Coull, George, D.Sc., Pharmaceutical Chemist, Smith's Place House, Leith	
1928		* Coutie, Rev. Alexander, B.Sc., Ph.D., South Manse, Fraserburgh, Aberdeenshire	
1914		* Coutts, William Barron, M.A., B.Sc., Senior Lecturer in Range Finding and Optics, Military College of Science, Red Barracks, Woolwich, S.E. 18. 11 Coleraine Road, Blackheath, S.E. 3	
1911		* Cowan, Alexander, Papermaker, Valleyfield, Penicuik, Midlothian	
1920		Craib, William Grant, M.A. (Aberdeen), Regius Professor of Botany in the University of Aberdeen	
1916	C.	† Craig, E. H. Cunningham, B.A. (Cambridge), Geologist and Mining Engineer, The Dutch House, Beaconsfield	
1908		Craig, James Ireland, M.A., B.A., Woolwich House, The Drive, Sydenham, London, S.E. 26. (At present—Turf Club, Cairo)	
1925	C. K.	* Craig, Robert Meldrum, M.A., B.Sc., F.G.S., Lecturer in Economic Geology in the University of Edinburgh	
1903		Crawford, Lawrence, M.A., D.Sc., Professor of Pure Mathematics, The University, Cape Town	
1922	C.	* Crew, Francis Albert Eley, M.D., Ch.B., D.Sc., Ph.D., Professor of Animal Genetics in the University of Edinburgh, and Director of the Animal Breeding Research Station. 10 Salisbury Road, Edinburgh	1928—
1870		Crichton-Browne, Sir Jaa., Kt., M.D., LL.D., D.Sc., F.R.S., Vice-President and Treasurer of the Royal Institution of Great Britain. 45 Hans Place, London, S.W. 1	
1916		* Crombie, James Edward, M.A., LL.D., Millowner, Parkhill House, Dyce, Aberdeenshire	
1929		* Cruickshank, Ernest William Henderson, M.D., D.Sc., Ph.D., Professor of Physiology, Dalhousie University, Halifax, Nova Scotia	
1914		* Cumming, Alexander Charles, O.B.E., D.Sc., Roselands, Crescent Road, Blundell Sands, Liverpool	
1928		* Cumming, William Murdoch, D.Sc. (Glasg.), F.I.C., M.Inst.Chem.E., Senior Lecturer on Organic Chemistry, Royal Technical College, Glasgow. "Bonnie-blink," 4 Newlands Road, Newlands, Glasgow	
1917		* Cunningham, Brysson, D.Sc., B.E., M.Inst.C.E., Lecturer on Waterways, Harbours, and Docks, University College, London. 141 Copers Cope Road, Beckenham, Kent	
1930		* Cunningham, John, C.I.E., B.A., M.D., Lt.-Colonel, Indian Medical Service. 2 Murrayfield Avenue, Edinburgh	
1898		Currie, James, M.A. Cantab., LL.D., Larkfield, Goldenacre, Edinburgh	Treas. 1906-26. V.P. 1926-29.
1904		Cuthbertson, John, Secretary, West of Scotland Agricultural College, 6 Charles Street, Kilmarnock	
1885		Daniell, Alfred, M.A., LL.B., D.Sc., Advocate, The Athenæum Club, Pall Mall, London	
1924		* Darwin, Charles Galton, M.A., F.R.S. (SECRETARY TO ORDINARY MEETINGS), Tait Professor of Natural Philosophy in the University of Edinburgh. 14 Heriot Row, Edinburgh	1925-28. Sec. 1928—
1921		* Datta, Rasik Lal, D.Sc., Industrial Chemist to the Government of Bengal Department of Industries. 14A Jagadish Nath Roy Lane, Calcutta, India	
1930	C. A.	* Davies, Lewis Merson, F.G.S., Lt.-Colonel, Royal Artillery, Officer Commanding the Scottish Coast Defences. Erlington, Kaimes Road, Corstorphine, Edinburgh	
1928		Dawson, Warren Royal, F.R.S.L., Honorary Librarian of Lloyd's, 28 Grange Road, Barnes, London, S.W. 13	

# Alphabetical List of the Ordinary Fellows of the Society. 383

Date of Election.			Service on Council, etc.
1917		* Day, T. Cuthbert, Partner of the firm of Hislop & Day. 36 Hillside Crescent, Edinburgh	
1923		* Deane, Arthur, M.R.I.A., Curator, Public Art Gallery and Museum, Belfast. Threave, Saintfield Road, Newtownbreda, Belfast	
1894		† Denny, Sir Archibald, Bart., LL.D., 5 St Helen's Place, London, E.C. 4	
1906		† Dewar, Thomas William, M.D., F.R.C.P., Kinesirn, Dunblane	
1926		Dey, Alexander John, Managing Director of T. & H. Smith, Ltd., Manufacturing Chemists, Blandfield Works, Edinburgh. Rothiemay, Corstorphine, Edinburgh	
1876	C.	Dickson, J. D. Hamilton, M.A., Senior Fellow and formerly Tutor, St Peter's College, Cambridge	
1924		* Dinham, C. H., B.A., Geological Survey, 28 Jernyn Street, London, S.W. 1	
1885	C.	Dixon, James Main, M.A., Litt. Hum. Doctor, Professor of English, University of Southern California. University Avenue, Los Angeles, California, U.S.A.	
1923		* Dixon, Ronald Audley Martineau, of Thearne, F.G.S., F.S.A.Scot., F.R.G.S., Thearne Hall, near Beverley	
1897		Dobbie, James Bell, F.Z.S., 12 South Inverleith Avenue, Edinburgh	
1881	C.	Dobbin, Leonard, Ph.D., formerly Reader in Chemistry in the University of Edinburgh. Faladam, Blackshiels, Midlothian	1904-07, 1918-16.
1918		* Dodd, Alexander Scott, B.Sc., Ph.D., F.I.C., F.C.S., City Analyst for Edinburgh. 20 Stafford Street, Edinburgh	
1925		* Donald, Alexander Graham, M.A., F.F.A., F.S.A.Scot., Secretary of the Scottish Provident Institution, Edinburgh. 18 Carlton Terrace, Edinburgh	
1905		Donaldson, Rev. Wm. Galloway, J.P., F.R.G.S., F.E.I.S., The Manse of Forfar, Forfar	
1882	C.	Dott, David B., F.I.C., Memb. Pharm. Soc., Ravenslea, Musselburgh	
1921	M-B.	* Dougall, John, M.A., D.Sc., Publisher's Reader, 47 Cornwall Avenue, Jordanhill, Glasgow	
1901	C.	Douglas, Carstairs Cumming, M.D., D.Sc., Professor of Medical Jurisprudence and Hygiene, Anderson's College, Glasgow. 110 South Brae Drive, Jordanhill, Glasgow	
1918		Douglas, Loudon MacQueen, Author and Lecturer, Newpark, Mid-Calder, Midlothian	
1910			
1923	C.	* Drever, James, M.A., B.Sc., D.Phil., Reader in Psychology, University of Edinburgh. Ivybank, Wardie Road, Edinburgh	1929-
1901		Drinkwater, Thomas W., L.R.C.P.E., L.R.C.S.E., Chemical Laboratory, Surgeons' Hall, Edinburgh	
1917		* Dron, Robert W., M.A., M.Inst.C.E., M.Inst.M.E., Professor of Mining in the University of Glasgow. 17 Blythswood Square, Glasgow	
1928		* Drummond, J. Montagu F., M.A. (Cantab.), Harrison Professor of Botany in the University of Manchester	1928-
1925		* Dryerre, Henry, M.R.C.S., Ph.D., Lecturer in Physiology in the University of Edinburgh. Kenmore, Lasswade	
1921		* Drysdale, Charles Vickery, O.B.E., D.Sc. (Lond.), M.I.E.E., F.Inst.P., Director of Scientific Research and Experiment to the Admiralty, S.R.E. Department. Archway Block N., Admiralty, Whitehall, London, S.W. 1	
1904		Dunlop, William Brown, M.A., 4a St Andrew Square, Edinburgh	
1903		Dunstan, John, M.R.C.V.S., Inversnaid, Liskeard, Cornwall	
1892	C.	Dunstan, M. J. R., M.A., F.I.C., F.C.S., formerly Principal, Royal Agricultural College, Cirencester. Windyacre, Wrotham, Kent	
1906	C.	Dyson, Sir Frank Watson, K.B.E., M.A., D.Sc., LL.D., F.R.S., Astronomer Royal, Royal Observatory, Greenwich	1907-10.
1925		* Eastwood, George Samuel, B.Sc., Principal Teacher of Mathematics, Beath Secondary School, Cowdenbeath, Fife. Craigie Lea, Cowdenbeath, Fife	
1904		Edwards, John, LL.D., 4 Great Western Terrace, Kelvinside, Glasgow	
1904		Elder, William, M.D., F.R.C.P.E., 6 John's Place, Leith	
1924		* Elliot, Walter Elliot, M.C., M.B., Ch.B., D.Sc., LL.D., M.P., 14 Markham Square, Chelsea, London	
1906	C.	Ellis, David, D.Sc., Ph.D., Professor of Botany and Bacteriology, Royal Technical College, Glasgow	
1924		* Evans, Arthur Humble, M.A., Sc.D., Lecturer in English History (under Special Board), Cheviot House, Crowthorne, Berks	
1924		Evans, William Edgar, B.Sc., Assistant in charge of Herbarium, Royal Botanic Garden, Edinburgh	

Date of Election.			Service on Council, etc.
1879	C. N.	Ewart, James Cossar, M.D., LL.D., F.R.C.S.E., F.R.S., F.Z.S., formerly Regius Professor of Natural History, University of Edinburgh. Craigyfield, Penicuik, Midlothian	1882-85, 1904-07. V-P 1907-12.
1902		Ewen, John Taylor, O.B.E., B.Sc., M.I.Mech.E., J.P., H.M. Inspector of Schools (Emeritus), Pitseandly, Forfar	
1878	C.	+ Ewing, Sir James Alfred, K.C.B., M.A., D.Sc., LL.D., F.R.S., Hon. Memb. Inst.C.E., J.P., formerly Principal of the University of Edinburgh and Director of Naval Education, Admiralty. 5 Herschel Road, Cambridge	1888-91, 1919-20. V-P 1920-23. P 1924-28.
1900	C.	Eyre, John W. H., M.D., M.S. (Dunelm), D.P.H. (Camb.), Professor of Bacteriology, Guy's Hospital, London	
1910	C.	* Fairgrieve, Mungo M'Callum, M.A. (Camb. and Glasg.), Master at the Edinburgh Academy. 37 Queen's Crescent, Edinburgh	
1907	C.	Falconer, John Downie, M.A., D.Sc., F.G.S., Director of the Geological Survey of Nigeria. The Cedars, Hatton Road, Harlington, Middlesex	
1923		* Feldman, William Moses, M.D., B.S., M.R.C.P. (Lond.), M.R.C.S. (Eng.), Physician, St Mary's Hospital for Women and Children, Plaistow. 861 Finchley Road, London, N.W. 11	
1928		* Fenton, Edward Wyllie, M.A., B.Sc. (Aberd.), Head of Biological Department, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh	
1899		+ Fergus, Andrew Freeland, M.D., LL.D., Farnycrag, Crichton Road, Rothesay	
1907		* Fergus, Edward Oswald, c/o Messrs M'Kay & Boyd, Solicitors, 50 Wellington Street, Glasgow	
1904		Ferguson, James Haig, M.D., LL.D., F.R.C.P.E., F.R.C.S.E., 7 Coates Crescent, Edinburgh	
1925	C.	* Ferrar, William Leonard, M.A., Fellow and Tutor of Hertford College, Oxford	
1927	C.	* Finlay, Thomas Matthew, M.A., D.Sc. (Edin.), Lecturer in Palaeontology in the University of Edinburgh. 11 Dudley Terrace, Leith	
1911		+ Fleming, John Arnold, F.C.S., etc., Pottery Manufacturer, Locksley, Helensburgh, Dumbartonshire	
1906		Fleming, Robert Alexander, M.A., M.D., LL.D., F.R.C.P.E., Consulting Physician, Royal Infirmary. 10 Chester Street, Edinburgh	
1900	C. N.	Flett, Sir John S., K.B.E., M.A., D.Sc., LL.D., F.R.S., Director of the Geological Survey of Great Britain and of the Museum of Practical Geology, London, 28 Jermyn Street, S.W. 1	1916-19.
1872		Forbes, George, M.A., LL.D., F.R.S., M.Inst.C.E., M.Inst.E.E., F.R.A.S., formerly Professor of Natural Philosophy in Anderson's College, Glasgow. 11 Little College Street, Westminster, S.W.	
1892		Ford, John Simpson, F.C.S., 7 Corranrie Drive, Edinburgh	
1921		* Forrest, George Topham, F.R.I.B.A., F.G.S., F.S.Arc., Architect to the London County Council, and Superintending Architect of Metropolitan Buildings, The County Hall, Westminster Bridge, London, S.E. 1	
1928	C.	* Forrest, James, M.A., B.Sc. (Glasg.), D.Sc. (St Andrews), Lecturer in Physics, University College, Dundee. "Cumbræ," Oxford Street, Blackness, Dundee	
1926		* Francis, Richard Taunton, F.Z.S., M.B.O.U., Printer and Publisher, of Messrs Taylor & Francis, Red Lion Court, London, E.C. Fairhaven, Peaks Hill, Purley, Surrey	
1920	C.	* Franklin, Thomas Bedford, B.A. (Hons. Mathematics), Cambridge, Stancliffe Hall, near Matlock, Derbyshire	
1910		* Fraser, Alexander, Actuary, 15 S. Learmonth Gardens, Edinburgh	
1929		* Fraser, David Kennedy, M.A., B.Sc., Lecturer in charge of course for training of Teachers of mentally defective children under Scottish National Committee, Psychologist to Glasgow Education Authority. Edge o' the Moor, Milngavie, Dumbartonshire	
1928		* Fraser, John, M.C., M.D., Ch.M., F.R.C.S.E., Regius Professor of Clinical Surgery in the University of Edinburgh. 32 Moray Place, Edinburgh	
1916		* Fraser, Rev. Joseph Robert, The New Manse, Kinneff, Inverberrie, Montrose	
1928		* Fraser, Kenneth, M.D. (Edin.), D.P.H. (Camb.), D.T.M. (Edin.), Deputy County Medical Officer of Health, Cumberland. The Croft, Scotby, near Carlisle	
1914		* Fraser, William, Managing Director, Neill & Co., Ltd., Printers, 212 Causeway-side, Edinburgh	

# Alphabetical List of the Ordinary Fellows of the Society. 385

Date of Election.			Service on Council, etc.
1896	C.	Fraser-Harris, David Fraser, B.Sc. (Lond.), D.Sc. (Birm.), M.D., formerly Professor of Physiology in the Dalhousie University, Halifax, Nova Scotia. Grove Park Lodge (3), Chiswick, London, W. 4	
1907		* Galbraith, Alexander, "Ravenswood," Dalmeir, Glasgow	
1888	C.	Galt, Alexander, D.Sc., formerly Keeper of the Department of Technology, Royal Scottish Museum, Edinburgh, c/o Clydesdale Bank, 1 Melville Place, Edinburgh	
1901		Ganguli, Sanjiban, M.A., Principal, Maharaja's College, and Director of Public Instruction, Jaipur State, Jaipur, India	
1923		* Gardiner, Frederick, M.D., B.Sc., F.R.C.S.E., F.R.S.M., Lecturer in Diseases of the Skin in the University of Edinburgh: Physician to the Royal Infirmary. 35 Manor Place, Edinburgh	
1926		* Gardner, John Davidson, B.Sc., Assoc.M.Inst.C.E., Chief Assistant to Messrs D. & C. Stevenson, Civil Engineers, Edinburgh. 23 Ivy Terrace, Edinburgh	
1930	C.	* Geddes, Alexander Ebenezer M'Lean, D.Sc., M.A., D.Sc. (Aberd.), Lecturer in Natural Philosophy in the University of Aberdeen. 12 Louisville Avenue, Aberdeen	
1909	C.	* Geddes, Rt. Hon. Sir Auckland C., G.C.M.G., K.C.B., P.C., M.D., D.C.L., formerly British Ambassador to the U.S.A. Athenaeum Club, Pall Mall, London	
1880	O.	Geddes, Patrick, formerly Professor of Sociology and Civics, University of Bombay, India. Collège des Écossais, Montpellier, France	
1914		Gemmell, John Edward, M.B., C.M., Hon. Surgeon, Hospital for Women and Maternity Hospital; Hon. Gynaecologist, Victoria Central Hospital, Liscard. Beechlands, Mossley Hill, Liverpool	
1909		* Gentle, William, B.Sc., Head Master, George Heriot's School. 10 West Savile Road, Edinburgh	
1920	C.	* Ghosh, Sudhanoy, M.Sc. (Cal.), D.Sc. (Edin.), F.C.S., Professor of Chemistry, School of Tropical Medicine and Hygiene, Central Avenue, Calcutta, India	
1914		* Gibb, Sir Alexander, G.B.E., C.B., M.Inst.C.E., Consulting Civil Engineer, Queen Anne's Lodge, Westminster, London, S.W. 1	
1916		* Gibb, Alfred William, M.A., D.Sc., Professor of Geology in the University of Aberdeen. 1 Belvidere Street, Aberdeen	
1910	C.	* Gibb, David, M.A., B.Sc., Lecturer in Mathematics, Edinburgh University. 15 South Lauder Road, Edinburgh	
1917	C.	* Gibson, Alexander, M.B., Ch.B., F.R.C.S. (Eng.), 661 Broadway, Winnipeg, Canada	
1910		* Gibson, Charles Robert, LL.D., Lynton, Manswood, by Pollokshaws	
1921		* Gibson, Walcot, D.Sc., F.R.S., F.G.S., formerly Assistant Director, H.M. Geological Survey (Scotland), Pathways, Fairlight Road, Hythe, Kent	
1911		Gidney, Lt.-Col. Henry A. J., F.R.C.S., D.O., D.P.H., J.P. M.I.A., I.M.S. (retired), Army Specialist Public Health, c/o The Allahabad Bank, Ltd., Calcutta, India	
1925		* Gillies, William King, M.A., B.A., F.E.I.S., Rector of the Royal High School, Edinburgh. Davaar, 12 Suffolk Road, Edinburgh	
1907		Gilruth, John Anderson, M.R.C.V.S., D.V.Sc. (Melb.), Clowes Street, South Yarra, Melbourne, Australia	
1909		* Gladstone, Hugh Stewart, M.A., M.R.O.U., F.Z.S., Capenoch, Thornhill, Dumfriesshire	
1911		Gladstone, Reginald John, M.D., F.R.C.S. (Eng.), Lecturer and Senior Demonstrator of Anatomy, King's College, University of London. 22 Regent's Park Terrace, London, N.W.	
1898		Glaister, John, M.D., F.R.F.P.S. (Glas.), D.P.H. (Camb.), Regius Professor of Forensic Medicine and Public Health in the University of Glasgow. 8 Newton Place, Glasgow	
1925	C.	* Goldie, Archibald Hayman Robertson, M.A., B.A., Superintendent, Meteorological Office, Air Ministry, Edinburgh. 6 Drumsheugh Gardens, Edinburgh	1929-
1910		Goodall, Joseph Strickland, M.B. (Lond.), M.R.C.P., F.R.C.S. Ed., M.S.A. (Eng.), Professor of Physiology and Biology, City of London Hospital. 136 Harley Street, London, W. 1	
1901		Goodwillie, James, M.A., B.Sc., Liberton, Edinburgh	
1920	C.	* Gordon, William, B.Sc., Ph.D., A.M.I. Mech.E., Lecturer in Engineering in the University of Edinburgh. 3 Wellington Street, Edinburgh	
1918	C.	* Gordon, William Thomas, M.A., D.Sc. (Edin.), M.A. (Cantab.), Professor of Geology, University of London, King's College, Strand, W.C.	
1897	M.B.	Gordon-Munn, John Gordon, M.D., Croys, Dalbeattie	

Date of Election.		Service on Council, etc.
1923	* Grabham, George Walter, O.B.E., M.A. (Cantab.), F.G.S., Government Geologist, Anglo-Egyptian Sudan. Box 178, Khartoum	
1924	Graham, Robert James Douglas, M.A., D.Sc., Lecturer in Plant Physiology in the University of Edinburgh. Royal Botanic Garden, Edinburgh	
1898	C. Gray, Albert A., M.D., 4 Clairmont Gardens, Glasgow	
1909	C. * Gray, James Gordon, D.Sc., Professor of Applied Physics in the University of Glasgow. 11 The University, Glasgow	1913-15.
1918	* Gray, Wm. Forbes, F.S.A.Scot., Editor and Author, 8 Mansionhouse Road, Edinburgh	
1927	C. * Greenwood, Alan William, M.Sc. (Melb.), Ph.D. (Edin.), Lecturer in the Animal Breeding Research Department, University of Edinburgh	
1922	* Greenwood, William Osborne, M.D. (Leeds), B.S. (Lond.), L.S.A., Obstetric Surgeon and Physician, Woodroyc, 19 Ripon Road, Harrogate, Yorks	
1905	C. K. † Gregory, John Walter, D.Sc., LL.D., F.R.S., formerly Professor of Geology in the University of Glasgow. Bassetts, Little Baddow, Chelmsford	1908-11. V-P 1920-23.
1925	* Greig, David Middleton, M.B., C.M., F.R.C.S.E., Conservator of the Museum of the Royal College of Surgeons of Edinburgh. 12 Abbotsford Cres., Edinburgh	
1906	Greig, Edward David Wilson, C.I.E., M.D., D.Sc., Lt.-Col., H.M. Indian Medical Service, 38 Coates Gardens, Edinburgh	
1905	† Greig, Sir Robert Blyth, M.C., LL.D., Secretary to the Department of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh	1921-24. V-P 1924-27.
1910	* Grimshaw, Percy Hall, Assistant Keeper, Natural History Department, The Royal Scottish Museum. 49 Lygon Road, Edinburgh	
1899	† Guest, Edward Graham, M.A., B.Sc., J.P., formerly City Treasurer, Edinburgh. 5 Newbattle Terrace, Edinburgh	
1927	* Gulland, John Masson, M.A. (Oxon.), D.Sc. (Edin.), Ph.D. (St Andrews), University Demonstrator in Chemistry in the University of Oxford. 283 Woodstock Road, Oxford	
1907	* Gulliver, Gilbert Henry, D.Sc., A.M.I.Mech.E., 99 Southwark Street, London, S.E.	
1930	* Guthrie, Douglas, M.D., F.R.C.S., Lecturer in Diseases of the Ear, Nose, and Throat, School of Medicine of the Royal Colleges, Edinburgh. 4 Rothesay Place, Edinburgh	
1911	* Guy, William, F.R.C.S., L.R.C.P., L.D.S.Ed., Consulting Dental Surgeon, Edinburgh Royal Infirmary; Dean, Edinburgh Dental Hospital and School; Lecturer on Human and Comparative Dental Anatomy and Physiology, 11 Wemyss Place, Edinburgh	
1922	* Hannay, Robert Kerr, M.A., Professor of Ancient History and Palaeography in the University of Edinburgh. Historiographer-Royal for Scotland. 5 Royal Terrace, Edinburgh	
1928	* Hanneford-Smith, William, Assoc.Inst.C.E., Hon. A.R.I.B.A., Member of the Institute of Metals, 3 The Avenue, Gravesend, Kent	
1918	* Hardie, Patrick Sinclair, M.A., B.Sc., c/o Mrs Taylor, 151 Bruntsfield Place, Edinburgh	
1928	* Harding, William Gerald, F.R.Hist.S., F.S.A.Scot., F.E.S., 3 Rawlinson Road, Oxford	
1923	C. * Harris, Robert Graham, M.A., D.Sc. (Edin.), (Aeronautical) Research Physicist, Lorraine, Manor Road, Farnborough, Hants	
1914	Harrison, Edward Philip, Ph.D., F.Inst.P., Chief Scientist, H.M.S. "Vernon," Portsmouth	
1921	* Harrison, John William Heslop, D.Sc. (Durham), F.R.S., Professor of Botany, Armstrong College, Newcastle. The Avenue, Birtley, Co. Durham	
1926	C. * Harrower, John Gordon, M.B., Ch.B. (Glas.), D.Sc. (Edin.), Professor of Anatomy, King Edward VII. Medical College, Singapore	
1926	* Harvey, William Frederick, C.I.E., M.A., M.B., C.M., D.P.H., Lieut.-Col. I.M.S. (retired), Histologist, Research Laboratory, Royal College of Physicians, Edinburgh. 56 Garscube Terrace, Edinburgh	
1898	Hehir, Sir Patrick, K.C.I.E., C.B., C.M.G., F.R.C.P.E., F.R.C.S.E., D.P.H. (Camb.), D.T.M. (Liv. Univ.), Maj.-General I.M.S. (retired), Ennisfarnie, Westward Ho, Devon	
1900	Henderson, John, D.Sc., A.Inst.E.E., Kinnoull, Gregory's Road, Beaconsfield, Bucks	
1929	* Henderson, Thomas, J.P., F.S.A.Scot., Actuary of the Savings Bank of Glasgow. 5 Belmont Crescent, Glasgow, W.2	
1908	* Henderson, William Dawson, M.A., B.Sc., Ph.D., Lecturer, Zoological Laboratories, University, Bristol	

# Alphabetical List of the Ordinary Fellows of the Society. 387

Date of Election.			Service on Council, etc.
1890	C.	Hepburn, David, C.M.G., M.D., formerly Professor of Anatomy in the University College of South Wales and Monmouthshire, 61 Ninian Road, Cardiff	
1925		* Heron, Alexander Macmillan, D.Sc., Officiating Superintendent, Geological Survey of India, Calcutta, India	
1916		* Herring, Percy Theodore, M.D., F.R.C.P. Ed., Professor of Physiology, University of St Andrews. Linton, St Andrews	1917-20.
1922		Hindle, Edward, M.A. (Cantab.), Ph.D., A.R.C.Sc., London School of Hygiene and Tropical Medicine. 23 Endsleigh Gardens, London, N.W. 1	
1902		Hinxman, Lionel W., B.A., formerly of the Geological Survey of Scotland. 4 Morant Gardens, Ringwood, Hants	
1904		Hobday, Frederick T. G., C.M.G., F.R.C.V.S., Principal, Royal Veterinary College, Camden Town, London, N.W. 1	
1928	C.	* Hobson, Alfred Dennis, M.A. (Camb.), Lecturer in Zoology in the University of Edinburgh. 71 Newington Road, Edinburgh	
1928		* Hodge, William Vallance Douglas, M.A. (Edin.), M.A. (Camb.), Lecturer in Mathematics in the University of Bristol	
1885		Hodgkinson, W. R., C.B.E., M.A., Ph.D., F.I.C., F.C.S., formerly Professor of Chemistry and Physics at the Ordnance College, Woolwich. 89 Shooter's Hill Road, Blackheath, Kent	
1923		* Hogben, Lancelot Thomas, M.A., D.Sc., Professor of Social Biology (London School of Economics), University of London	
1927		Holden, Henry Smith, D.Sc., F.L.S., Professor of Botany, University College, Nottingham	
1930		* Holland, Sir Thomas Henry, K.C.S.I., K.C.I.E., Hon. D.Sc., LL.D., F.R.S., Principal of the University of Edinburgh.	
1911		Holland, William Jacob, LL.D. (St Andrews), Director, Carnegie Institute, Pittsburg, Pa. 5545 Forbes Street, Pittsburg, Pa., U.S.A.	
1929		* Hora, Sunder Lal, D.Sc. (Punjab et Edin.), F.L.S., F.Z.S., F.A.S.B., Senior Assistant Superintendent, Zoological Survey of India. Indian Museum, Calcutta	
1920	C.	* Horne, Alexander Robert, O.B.E., B.Sc., M.I.Mech.E., A.M.I.C.E., Professor of Mechanical Engineering, Heriot-Watt College, Edinburgh. 31 Queen's Crescent, Edinburgh	
1896		Horne, J. Fletcher, M.D., F.R.C.S.E., Shelley Hall, Huddersfield	
1904	C.	Horsburgh, Ellice Martin, M.A., D.Sc., Reader in Technical Mathematics, University of Edinburgh. 11 Granville Terrace, Edinburgh	
1897		Houston, Sir Alex. Cruikshanks, K.B.E., C.V.O., M.B., C.M., D.Sc., 20 Nottingham Place, London, W. 1	
1912	C.	* Houstoun, Robert Alexander, M.A., Ph.D., D.Sc., Lecturer in Physical Optics, University, Glasgow. 45 Kirklee Road, Glasgow	1929-
1898	M-B.	Howden, Robert, M.A., M.B., C.M., D.Sc., LL.D., Etn. Professor of Anatomy in the University of Durham. Broomfield, Crief	
1910		Hume, William Fraser, D.Sc. (Lond.), Director, Geological Survey of Egypt, Helwan, Egypt. The Laurels, Rustington, Sussex	
1927		* Hunt, Owen Duke, B.Sc. (Manch.), "Hillside," Court Wood, Newton Ferrers, S.O., Devon	
1928		* Hunter, Rev. Adam Mitchell, M.A., D.Litt., Librarian of New College, Edinburgh. 3 Suffolk Road, Edinburgh	
1928		* Hunter, Arthur, F.F.A., LL.D. (Edin.), Vice-President and Chief Actuary of the New York Life Insurance Co. 124 Lloyd Road, Montclair, N.J., U.S.A.	
1916		* Hunter, Charles Stewart, L.R.C.P.E., L.R.C.S.E., D.P.H., Cotawold, 36 Streatham Hill, London, S.W. 2	
1911		Hunter, Gilbert Macintyre, M.Inst.C.E., M.Inst.E.S., M.Inst.M.E. Resident Engineer, Nitrate Railways, Iquique, Chile	
1887	C.	Hunter, William, C.B., M.D., M.R.C.P.L. and E., M.R.C.S., LL.D., 103 Harley Street, London	
1927		* Hyslop, James, M.A. (Glasg.), Ph.D. (Camb.), Lecturer in Mathematics in the University of Glasgow	
1908		Hyslop, Theophilus Bulkeley, M.D., M.R.C.P.E., 5 Portland Place, London, W. 1	
1928	C.	* Ince, Edward Lindsay, M.A. (Cantab.), D.Sc. (Edin.), Professor of Pure Mathematics, Egyptian University, Cairo. Gabalaya House, Zamalek, Cairo, Egypt	
1920		* Inglis, James Gall, Publisher and Editor of Educational Works, 36 Blacket Place, Edinburgh	



Date of Election.			Service on Council, etc.
1927		* Inglis, John Alexander, of Auchindinny and Redhall, K.C., M.A. (Oxon.), LL.B. (Edin.), King's and Lord Treasurer's Remembrancer. 13 Randolph Crescent, Edinburgh	
1912		* Inglis, Robert John Mathieson, M.Inst.C.E., Assistant Chief Engineer, Lond. & N.E. Railway, Liverpool Street Station, London. Tantal, Peebles	
1904	C.	Imes, Robert T. A., formerly Director, Government Observatory, Johannesburg, Transvaal	
1917		* Irvine, Sir James Colquhoun, C.B.E., D.L., Ph.D., D.Sc. (Liverpool, Princeton), LL.D., Hon. Sc.D. (Yale), Sc.D. (Camb.), F.R.S., Hon. Mem. American Chemical Society, Principal of the University of St Andrews	1920-22. V.P.
1930	C.	* Jack, David, M.A., B.Sc. (Edin.), Ph.D. (St Andrews), Assistant in Natural Philosophy and Carnegie Teaching Fellow in the University of St Andrews. 22 Grange Road, St Andrews	1922-25.
1923		* Jack, John Louttit, Solicitor, Assistant Secretary, Department of Health for Scotland, 121A Princes Street, Edinburgh	
1889	C.	James, Alexander, M.D., F.R.C.P.E., Huntington, Haddington.	
1901		Jardine, Robert, M.D., M.R.C.S., F.R.F.P.S. (Glas.), Wiston Manse, Lamington	
1912	C.	* Jeffrey, George Rutherford, M.D. (Glas.), F.R.C.P. (Edin.), Bootham Park Private Mental Hospital, York	
1906	C. K.	Jehu, Thomas John, M.A., M.D., F.G.S. (VICE-PRESIDENT). Professor of Geology in the University of Edinburgh. 35 Great King Street, Edinburgh	1917-20, 1923-26. V.P.
1900		† Jerdan, David Smiles, M.A., D.Sc., Ph.D., 26 Avenue du Château d'Eau, Saventhem, Belgium	1929-
1925		* Johnston, Christopher Nicholson, The Hon. Lord Sands, Kt., K.C., LL.D., D.D., Senator of the College of Justice. 4 Heriot Row, Edinburgh	
1895		Johnston, Col. Henry Halero, C.B., C.B.E., D.Sc., M.D., F.L.S., late A.M.S., Orphir House, Kirkwall, Orkney	
1928		* Johnston-Saint, Percy Johnston, M.A. (Camb.), Secretary, Wellcome Historical Medical Museum, 54A Wigmore Street, London, W. 1. 4 Wyndham Place, Bryanston Square, London, W.	
1928		* Johnstone, Robert William, C.B.E., M.A., M.D. (Edin.), F.R.C.S.E., M.R.C.P.E., Professor of Midwifery and Diseases of Women in the University of Edinburgh. 26 Palmerston Place, Edinburgh	
1924		* Jones, David Thomas, C.B.E., Chairman, H.M. Fishery Board for Scotland, 101 George Street, Edinburgh	
1927		* Jones, Edward Taylor, D.Sc. (Lond.), Professor of Natural Philosophy in the University of Glasgow	1927-30
1888		Jones, John Alfred, M.Inst.C.E., Fellow of the University of Madras, Sanitary Engineer to the Government of Madras. (Address not known)	
1930	C.	* Jones, Samuel Griffith, D.Sc. (Univ. Wales), Lecturer in Botany in the University of Glasgow. Cliffe Holme, Thorn Drive, Bearsden, Dumbartonshire	
1928		* Jones, Tudor Jenkyn, M.B., Ch.B. (Glas.), Lecturer in Anatomy in the University of Liverpool	
1922		* Juritz, Charles Frederick, M.A., D.Sc., F.I.C., Chief of the Union Department of Chemistry, Villa Marina, Three Anchor Bay, Cape Town, South Africa	
1925	C.	* Kemp, Charles Norman, B.Sc., Technical Radiologist, Secretary of the Royal Scottish Society of Arts. Ivy Lodge, Laverockbank Road, Edinburgh	
1929		* Kendall, James, M.A., D.Sc., F.R.S., Professor of Chemistry, University of Edinburgh. 14 Mayfield Gardens, Edinburgh	
1912		† Kennedy, Robert Foster, M.D. (Queen's Univ., Belfast), M.B., B.Ch. (R.U.I.), Assoc. Professor of Neurology, Cornell University, New York. Ninth Floor, 410 East 57th Street, near First Avenue, New York, U.S.A.	
1927		* Kennedy, Walter Phillips, B.Sc., Ph.D. (Edin.) L.R.C.P. and S.E., Beit Memorial Research Fellow, Physiology Department, University, Edinburgh	
1909		Kenwood, Henry Richard, C.M.G., M.B., C.M., Chadwick Em. Professor of Hygiene in the University of London. "Wadhurst," Queen's Road, Finabury Park, London, N.	
1925	C.	* Kermack, William Ogilvy, M.A., D.Sc., Chemist to the Research Laboratory of the Royal College of Physicians, 2 Forrest Road, Edinburgh	
1908	M.B.	* Kerr, Andrew William, F.S.A.Scot., 81 Great King Street, Edinburgh	
1903 & 1923	C. N.	* Kerr, John Graham, M.A., F.R.S., F.L.S., F.Z.S. (VICE-PRESIDENT), Regius Professor of Zoology, University of Glasgow. 9 The University, Glasgow	1904-07, 1913-16, 1924-27. V.P.
			1928-

# Alphabetical List of the Ordinary Fellows of the Society. 389

Date of Election.			Service on Council, etc.
1927		* Kerr, John Martin Munro, M.D., F.R.F.P.S. (Glas.), Professor of Midwifery in the University of Glasgow	
1891		Kerr, Joshua Law, M.D., J.P., "Stonehaven," Sheffield, Tasmania	
1913		* Kerr, Walter Hume, M.A., B.Sc., formerly Lecturer on Engineering Drawing and Structural Design in the University of Edinburgh. Glenfriars, Jedburgh	
1926		* Khastgir, Satis Ranjan, M.Sc. (Calcutta), D.Sc. (Edin.), Ph.D. (Edin.), Physics Department, University College, Colombo, Ceylon	
1907		* King, Archibald, M.A., B.Sc., formerly Rector of the Academy, Castle Douglas; H.M. Inspector of Schools. St Anne's, Barassie, Ayrshire	
1925		* King, Leonard Augustus Lucas, M.A., Professor of Zoology in the West of Scotland Agricultural College, Glasgow. 48 University Avenue, Glasgow, W. 2	
1918		* Kingon, Rev. John Robert Lewis, M.A., D.Sc., F.L.S., 25 Innes Avenue, Bloemfontein, O.F.S., South Africa	
1901		Knight, Rev. G. A. Frank, M.A., D.D., F.S.A.Scot., 10 Hillhead Street, Glasgow	
1907		* Knight, James, M.A., D.Sc., F.C.S., F.G.S., J.P., Rector, Queen's Park High School, Langside, Glasgow	
1927		* Lambie, Charles George, M.C., M.B., Ch.B., F.R.C.P.E., Bosch Professor of Medicine in the University of Sydney	
1920	C.	* Lamont, John Charles, Lieut.-Col., I.M.S. (retired), C.I.E., M.B., C.M. (Edin.), M.R.C.S. (Eng.), 7 Merchiston Park, Edinburgh	
1925	C.	* Lang, William Henry, M.B., C.M., D.Sc., F.R.S., Barker Professor of Cryptogamic Botany in the University of Manchester	
1910	C.	* Lauder, Alexander, D.Sc., Head of Chemistry Department, Edinburgh (and East of Scotland College of Agriculture, 13 George Square, Edinburgh. Lecturer in Agricultural Chemistry, University of Edinburgh	1917-20. Sec.
1885	C.	Laurie, Arthur Pillans, M.A., D.Sc., LL.D., J.P., formerly Principal of the Heriot-Watt College, Edinburgh. 22A Buccleuch Place, Edinburgh	1923-28. 1908-11, 1918-16.
1921		* Laurie, The Rev. Albert Ernest, M.C., C.F., D.D., Rector of Old St Paul's, and Canon of St Mary's Cathedral, Edinburgh. Lauder House, Jeffrey Street, Edinburgh	
1894	C.	Laurie, Malcolm, B.A., D.Sc., F.L.S., 4 Wordsworth Road, Harpenden, Herts	
1905		Lawson, David, M.A., M.D., L.R.C.P. and S.E., Drumdarroch, Banchory, Kincardineshire	
1908		Leighton, Gerald Rowley, O.B.E., M.D., D.Sc., Medical Officer, Scottish Board of Health, 121A Princes Street, Edinburgh	
1930		* Lelean, Percy Samuel, C.B., C.M.G., F.R.C.S., L.R.C.P., D.P.H., Professor of Public Health in the University of Edinburgh. 2 Barnton Loan, Davidson's Mains, Edinburgh	
1910		Levie, Alexander, F.R.C.V.S., D.V.S.M., Balmae, Manor Road, Littleover, Derby	
1916	C.	* Levy, Hyman, M.A., D.Sc., Professor of Mathematics, Imperial College of Science and Technology, London, S.W. 7. 62 Kenilworth Avenue, Wimbledon Park, London, S.W. 19	
1914	O. N.	Lewis, Francis John, D.Sc., F.L.S., Professor of Biology, University of Alberta, Edmonton South, Alberta, Canada	
1918		* Lidstone, George James, F.F.A., F.I.A., LL.D., formerly Manager and Actuary of the Scottish Widows' Fund Life Assurance Society. Hermiston House, Hermiston, Currie, Midlothian	1919-22.
1905		Lightbody, Forrest Hay, 53 Queen Street, Edinburgh	
1923		* Lim, Robert Kho Seng, M.B., Ch.B., D.Sc., Ph.D., Peking Union Medical College, Department of Physiology, Peking, China	
1912		* Lindsay, John George, M.A., B.Sc. (Edin.), Rector of Dunfermline High School	
1920	C.	* Lindsay, Thomas A., M.A. (Hons.), B.Sc., Head Master, Higher Grade School, Bucksburn, Aberdeenshire	
1912		* Linlithgow, The Most Honourable the Marquis of, K.T., Hopetoun House, South Queensferry	
1903		† Liston, William Glen, C.I.E., M.D., Lt.-Col. Indian Medical Service (retired), Milburn Tower, Gogar, Corstorphine, Edinburgh	
1929		* Little, John Robert, F.C.I.L., F.C.I.S., General Manager and Secretary of the Century Insurance Co., Ltd. 5 Dalrymple Crescent, Edinburgh	
1926		* Lorraine, Norman Stanley Rees, M.D., D.P.H. (Edin. and Glasg.), Medical Officer of Health, Shoburness Urban District, and Assistant County Medical Officer of Health, County of Essex. Galton House, Galton Road, Westcliff-on-Sea, Essex	
1898		Lothian, Alexander Veitch, M.A., B.Sc., Glendoune, 996 Great Western Road, Glasgow	

Date of Election.			Service on Council, etc.
1930		* Low, James Wotherspoon, B.Sc. (Edin.), Ph.D. (Bristol), 5 Queen Street, Edinburgh	
1923	C.	* Ludlam, Ernest Bowman, M.A., D.Sc., Lecturer in Chemistry in the University of Edinburgh	
1900		† Lusk, Graham, M.A., Ph.D., LL.D., Professor of Physiology, Cornell University Medical College, New York, N.Y., U.S.A.	
1923		* Lyford-Pike, James, M.A., B.Sc., Lecturer in Forestry in the University of Edinburgh. Rosetta, Liberton, Edinburgh	
1924		* Lyon, David Murray, M.D., Ch.B., F.R.C.P.E., D.P.H., Professor of Therapeutics and Clinical Medicine in the University of Edinburgh. Dreghorn Loan, Colinton	
1894		Mabbott, Walter John, M.A., formerly Rector of County High School, Duns, Berwickshire. The Hawthorn, Farnham Lane, Haslemere, Surrey	
1917		* Macalister, Sir Donald, Bt., K.C.B., M.D., M.A., B.Sc., Chancellor of the University of Glasgow. Barnmore, Lady Margaret Road, Cambridge	
1920		* M'Arthur, Donald Neil, D.Sc., Ph.D., F.I.C., Professor of Agricultural Chemistry, West of Scotland Agricultural College, Glasgow, C.2. 35 Kersland Street, Glasgow, W. 2	
1921		* M'Arthur, Neil, M.A., B.Sc., Lecturer in Mathematics, Glasgow University. 1 Holyrood Crescent, Glasgow	
1926		* M'Bride, James Alexander, B.A. (Roy. Univ., Ireland), B.Sc. (Lond.), formerly Rector of Queen's Park Secondary School, Glasgow	
1883		M'Bride, Peter, M.D., F.R.C.P.E., 8 St Peter's Grove, York	
1930		* M'Candlish, Andrew Corrie, B.Sc. (Glasg.), M.S.A., Ph.D. (Iowa), Advisory Officer in Milk Production, West of Scotland Agricultural College. Claunch, Sorbie, Wigtownshire	
1923		* M'Cracken, William, J.P., F.S.I., F.H.A.S., Land Agent and Technical Adviser, Englesea House, Crewe	
1918		* M'Culloch, Rev. James David, 43 Brougham Street, Greenock	
1905		Maddonald, Hector Muir, O.B.E., M.A., F.R.S., Professor of Mathematics, University of Aberdeen. 52 College Bounds, Aberdeen	1903-11.
1897	C.	Maddonald, James A., M.A., B.Sc., formerly H.M. Inspector of Schools. "Rothes," Frankscoft, Peebles	
1904		Maddonald, John A., M.A., B.Sc. (Present address not known)	
1920		* M'Donald, Stuart, M.A., M.D., F.R.C.P.E., Professor of Pathology, University of Durham. College of Medicine, Newcastle-on-Tyne	
1928		* Macdonald, Thomas Logie, M.A., B.Sc. (Glasg.), F.R.A.S., 9 Colebrooke Terrace, Glasgow, W. 2	
1904		Macdonald, William, M.S. Agr., Sc.D., Ph.D., D.Sc., Editor, <i>Agricultural Journal</i> of South Africa. Rand Club, Johannesburg, Transvaal	
1886		Macdonald, William J., M.A., LL.D., 15 Conniston Drive, Edinburgh	
1901	C.	MacDougall, R. Stewart, M.A., D.Sc., Professor of Biology, Royal Veterinary College, Edinburgh. Ivy Lodge, Gullane, East Lothian	1914-17.
1910		Macewen, Hugh Allen, O.B.E., M.B., Ch.B., D.P.H. (Lond. and Camb.), Local Government Board, Ministry of Health, Whitehall, London, S.W.	
1888	C.	M'Fadyean, Sir John, Kt., M.B., B.Sc., LL.D., formerly Principal and Professor of Comparative Pathology in the Royal Veterinary College, Camden Town, London. Highlands House, Leatherhead	
1885	C.	† Macfarlane, J. M., D.Sc., LL.D., Em. Professor of Botany. 427 West Hansberry Street, Germantown, Pa., U.S.A.	
1897		MacGillivray, Angus, C.M., M.D., D.Sc., F.S.A.Scot., 23 South Tay Street, Dundee	
1878		M'Gowan, George, F.I.C., Ph.D., 21 Montpelier Road, Ealing, London, W. 5	
1922		* Macgregor, Murray, M.A., B.Sc., Assistant Director (Scotland), H.M. Geological Survey. 19 Grange Terrace, Edinburgh	1930-
1903		M'Intosh, Donald C., M.A., D.Sc., Education Offices, Elgin	
1911		M'Intosh, John William, M.R.C.V.S., Dollis Hill Farm, Cricklewood, London, N.W. 2	
1869	C. N.	† M'Intosh, William Carmichael, M.D., D.Sc., LL.D., F.R.S., F.L.S., Em. Professor of Natural History in the University of St Andrews, Pres. Ray Society, 2 Abbotsford Crescent, St Andrews	1885-88. V-P 1927-30.
1927	C.	* M'Intyre, Donald, M.B.E., M.D. (Glasg.), F.R.C.S.E., Assistant Physician, Glasgow Royal Maternity and Women's Hospital, and Glasgow Samaritan Hospital. 9 Park Circus, Glasgow, C. 3	
1912	C.	M'Kendrick, Anderson Gray, M.B., D.Sc., F.R.C.P.E., Lt.-Col., Indian Medical Service (retired), Superintendent, Research Laboratory, Royal College of Physicians, 2 Forrest Road, Edinburgh	1924-27.

# Alphabetical List of the Ordinary Fellows of the Society. 391

Date of Election			Service on Council, etc.
1914		* M'Kendrick, Archibald, F.R.C.S.E., D.P.H., L.D.S., 12 Rothesay Place, Edinburgh	
1900	C.	M'Kendrick, John Souttar, M.D., F.R.F.P.S. (Glas.), 2 Buckingham Terrace, Hillhead, Glasgow	
1910	C.	* Mackenzie, Alistair, M.A., M.D., D.P.H., Principal, College of Hygiene and Physical Training, Dunfermline	
1916	C.	* Mackenzie, John E., D.Sc., Reader in Chemistry, University of Edinburgh. 2 Ramsay Garden, Edinburgh	
1905		Mackenzie, Sir Wm. Colin, K.B., M.D., F.R.C.S., Director Australian Institute of Anatomy, Canberra, F.C.T., Australia	
1904	C.	Mackenzie, Sir W. Leslie, M.A., M.D., D.P.H., LL.D., F.R.C.P. (Edin.), formerly Medical Member of the Scottish Board of Health, 14 Belgrave Place, Edinburgh	
1926		* MacKichan, The Very Rev. Dugald, M.A., D.D., LL.D., formerly Principal of Wilson College, Bombay. 13 Learmonth Terrace, Edinburgh	
1929	C.	* Mackie, John, M.A., D.Sc., Mathematical Master, Leith Academy. 19 Beresford Avenue, Trinity, Leith	
1928		* Mackie, Thomas Jones, M.D., M.R.C.P. (Edin.), Professor of Bacteriology in the University of Edinburgh. 22 Mortonhall Road, Edinburgh	
1918		* Mackie, Wm., M.A., M.D., LL.D., D.P.H., 40 Clouston Street, Glasgow, N.W.	
1910		* MacKinnon, James, M.A., Ph.D., LL.D., Professor of Ecclesiastical History, Edinburgh University. 12 Lygon Road, Edinburgh	
1904		Mackintosh, Donald James, C.B., M.V.O., D.L., M.B., C.M., LL.D., Supt. Western Infirmary, Glasgow	
1899		Maclean, Sir Ewan John, M.D., M.R.C.P. (Lond.), J.P., Professor of Obstetrics and Gynecology, Welsh National School of Medicine, 12 Park Place, Cardiff	
1888	C.	Maclean, Magnus, M.A., D.Sc., LL.D., M.Inst.C.E., M.I.E.E., formerly Professor of Electrical Engineering in the Royal Technical College. 108 University Avenue, Glasgow, W. 2	1916-19.
1918		* M'Lellan, Dugald, M.Inst.C.E., Divisional Engineer, L.M. and S. Railway, Buchanan Street Station, Glasgow. 1 Queen's Gate, Dowanhill, Glasgow	
1916	C.	* M'Lintock, W. F. P., D.Sc. (Edin.), Museum of Practical Geology, 28 Jermyn Street, London, S. W. 1	
1923		* Macmillan, Rt. Hon. Lord, LL.D., 44 Grosvenor Road, Westminster, S. W. 1	
1917		* Macpherson, Rev. Hector Copland, M.A., Ph.D., F.R.A.S., Guthrie Memorial U.F. Church. 7 Wardie Crescent, Edinburgh	
1921		* M'Quistan, Dougald Black, M.A., B.Sc., Associate-Professor of Natural Philosophy, Royal Technical College, Glasgow. 29 Viewpark Drive, Rutherglen	
1921	C.	* MacRobert, Thomas Murray, M.A., D.Sc., Professor of Mathematics in the University of Glasgow. 10 The University, Glasgow	
1921	C.	* M'Whan, John, M.A. (Glasgow), Ph.D. (Gött.), Lecturer in Mathematics in the University of Glasgow. 84 Munro Road, Jordanhill, Glasgow, W. 3	
1927		* Madwar, Mohamed Reda, B.Sc., Ph.D. (Edin.), Assistant, Helwan Observatory, Egypt	
1898	C.	† Mahalanobis, S. C., B.Sc., (Edin.), Professor of Physiology, University of Calcutta, formerly Professor of Physiology, and sometime Dean, Presidency College, Calcutta. P. 45 New Park Street, Calcutta	
1918		Majumdar, Tarak Nath, D.P.H. (Cal.), L.M.S., F.C.S., Health Officer, Calcutta, IV, Calcutta, India. P. 235 Russa Road, P.O. Tollygunge	
1917		* Malcolm, L. W. Gordon, M.Sc. (Cantab.), Conservator, Wellcome Historical Medical Museum, 54 Wigmore Street, London, W. 1	
1908		Mallick, Devendranath, Sc.D., B.A., Principal, Carmichael College, Rungpur, Bengal, India	
1925		* Malloch, James, M.A., J.P., F.S.A.Scot., Executive Officer to the National Committee for the Training of Teachers. Earleville, Camperdown Street, Broughty Ferry	
1912		Maloney, William Joseph, M.B.E., M.C., M.D. (Edin.), LL.D., Professor of Neurology at Fordham University, New York City, N.Y., U.S.A.	
1918		Marchant, Rev. Sir James, K.B.E., LL.D., F.R.A.S., F.L.S., Director, National Council for Promotion of Race-Regeneration. Rhonda House, 60 Gower Street, London, W.C. 1	
1882	C.	Marshall, D. H., M.A., Em. Professor of Physics, Queen's University, Elmtree House, Union Street, W., Kingston, Ontario, Canada	
1901	C.	Marshall, Francis Hugh Adam, Sc.D., F.R.S., Reader in Agricultural Physiology in the University of Cambridge, Christ's College, Cambridge	

Date of Election.			Service on Council, etc.
1920	C.	* Marshall, John, M.A., D.Sc. (St Andrews), B.A. (Cantab.), University Reader in Mathematics, Bedford College, Regent's Park, London, N.W.1. Logan House, Torrington Park, North Finchley, London, N. 12	
1918		Masson, George Henry, M.D., D.Sc., F.R.C.P.E., Port of Spain, Trinidad, British West Indies	
1885	C.	Masson, Sir David Orme, K.B.E., M.A., D.Sc., LL.D., F.R.S., Em. Professor of Chemistry in the University of Melbourne	
1898	C.	Masterman, Arthur Thomas, M.A., D.Sc., F.R.S., formerly Superintending Inspector, H.M. Board of Agriculture and Fisheries. Royal Auto Club, Pall Mall, London, S.W. 3 Kedale Road, Seaford	1902-04.
	M.B.	Mathews, Gregory Macalister, M.B.O.U., Meadway, St Cross, Winchester, Hants	
1911		* Mathieson, John, F.R.S.G.S., late Division Superintendent, Ordnance Survey (retired), 42 East Claremont Street, Edinburgh	
1921		Mathieson, Robert, F.C.S., St Serf's, Innerleithen	
1906		* Matthai, George, M.A. (Camb.), F.Z.S., F.L.S., Professor of Zoology, The Government College, Lahore, India	
1928		Matthews, Ernest Romney, M.Inst.C.E., F.G.S., Chief Drainage Engineer to H.M. Office of Works. Caytor House, 143 Bedford Hill, Balham, London, S.W. 12	
1902		* Matthews, James Robert, M.A., F.L.S., Professor of Botany in the University of Reading	
1924		* Maylard, A. Ernest, M.B., B.Sc. (Lond.), F.R.F.P.S. (Glasgow), Kingsmuir, Peebles	
1917		* Meakins, Jonathan Campbell, M.D., LL.D., F.R.C.P.Ed., Professor of Medicine and Director of the Department of Medicine, McGill University, Montreal, Canada	
1922		* Mekie, David Clark Thomson, M.A., Ph.D., Head Master, Bonnington Road Public School, 11 Minto Street, Edinburgh	
1926		* Menzies, Alan W. C., M.A., B.Sc., Ph.D., F.C.S., Professor of Chemistry, Princeton University, Princeton, New Jersey, U.S.A.	
1901	C.	* Menzies, Frederick Norton Kay, M.D., F.R.C.P. (Edin.), D.P.H. (Lond.), Medical Officer of Health and School Medical Officer, Administrative County of London, County Hall, London, S.E.	
1927		* Mercer, Walter, M.B., Ch.B., F.R.C.S.E., Lecturer in Clinical Surgery, University of Edinburgh. 3 Rothesay Place, Edinburgh	
1929		* Merson, George Fowle, Manufacturing Technical Chemist, St John's Hill Works, Edinburgh	
1917		* Metzler, William H., A.B., Ph.D., Corresponding Fellow of the Royal Society of Canada, Dean of the New York State College for Teachers, Albany, N.Y., U.S.A.	
1902	C.	Mill, Hugh Robert, D.Sc., LL.D., Hill Crest, Dormans Park, E. Grinstead	
1885	C.	* Miller, John, M.A., D.Sc., Professor of Mathematics, Royal Technical College, 2 Northbank Terrace, North Kelvinside, Glasgow	
1910	M.B.	* Miller, William Christopher, M.R.C.V.S., Lecturer, Animal Breeding Research Department (Sheep Section), King's Buildings, West Mains Road, Edinburgh. Scotiawoode, Alnwickhill Road, Liberton, Edinburgh	
1930		Milne, Archibald, M.A., D.Sc., Deputy Director of Studies, Edinburgh Provincial Training College. 38 Morningside Grove, Edinburgh	
1905		Milne, C. H., M.A., D.Litt., Head Master, Daniel Stewart's College. 19 Merchiston Gardens, Edinburgh	
1905		Milne, James Robert, D.Sc., Lecturer in Natural Philosophy, University of Edinburgh. 7 Grosvenor Crescent, Edinburgh	
1904	C.	Milne, William, M.A., B.Sc., 70 Beechgrove Terrace, Aberdeen	
1886		Milroy, Thomas Hugh, M.D., B.Sc., LL.D., Professor of Physiology in Queen's University, Belfast	
1899			
1889	C.	Mitchell, A. Crichton, D.Sc., Hon. Doc. Sc. (Genève), formerly Director of Public Instruction in Travancore, India. 246 Ferry Road, Edinburgh. (Society's Representative on Governing Body of Heriot-Watt College)	1915-16. 1930- Cur. 1916-26. V.P. 1926-29.
1897		† Mitchell, George Arthur, M.A., 9 Lowther Terrace, Kelvinside, Glasgow	
1900		Mitchell, James, M.A., B.Sc., Islay Lodge, Lochgilphead, Argyll	
1911		Modi, Edalji Manekji, D.Sc., LL.D., Litt.D., F.C.S., etc., Proprietor and Director of Arthur Road Chemical Works, Meher Buildings, Tardeo, Bombay, India	
1908	C.	† Moffat, Rev. Alexander, M.A., LL.D., formerly Professor of Physics, Christian College, Madras. Alwaye, Travancore, India	

# Alphabetical List of the Ordinary Fellows of the Society. 393

Date of Election			Service on Council, etc.
1929		Moir, Henry, F.F.A., F.I.A., President, United States Life Insurance Co., in the City of New York, 105 Fifth Avenue, New York City. Upper Montclair, New Jersey	
1890	C.	+ Mond, Robert Ludwig, M.A. Cantab., LL.D., F.C.S., 9 Cavendish Sq., London, W. 1	
1887	C.	Moos, N. A. F., D.Sc., L.C.E., J.P., Director of Bombay and Alibag Observatories (retired), Gowalia, Tank Road, Bombay, India	
1896		Morgan, Alexander, M.A., D.Sc., formerly Principal, Edinburgh Provincial Training College. 1 Midmar Gardens, Edinburgh	
1930	*	* Morison, John Miller Woodburn, M.D., F.R.C.P.E., D.M.R. and E., Professor of Radiology in the University of London, and Director of the Radiological Department of the Cancer Hospital, Fulham Road, London, S.W. 3	
1926		* Morris, James Archibald, A.R.S.A., F.S.A. Scot., Savoy Croft, Ayr	
1919		* Morris, Robert Owen, M.A., M.D., C.M. (Edin.), D.P.H. (Liverpool), Tuberculosis Institute, Newtown, N. Wales	
1892	C.	Morrison, J. T., M.A., B.Sc., Professor of Mathematical Physics, University, Stellenbosch, Cape Colony	
1914		Mort, Spencer, M.D., Ch.B., Ch.M., F.R.C.S.E., Lieut.-Col., R.A.M.C., North Middlesex Hospital, Upper Edmonton, London, N 18	
1930	*	* Morton, James, LL.D., Chairman and Governing Director of the Scottish Dyes, Ltd. Craigiehall, Cramond Bridge, West Lothian	
1901		Moses, O. St John, M.D., D.Sc., F.R.C.S., Lt.-Col. I.M.S. (retired), formerly Professor of Medical Jurisprudence, Medical College, Calcutta. 18 Manstone Road, Cricklewood, London, N.W. 2	
1892	C. K.	Mossman, Robert Cockburn, Libertad 3923, Estación de Florida, F.C.C.A., Provincia de Buenos Aires, Argentine Republic	
1916		* Muir, Robert, M.A., M.D., Sc.D., LL.D., F.R.S., F.R.C.P. (Edin.), Professor of Pathology, University of Glasgow. 30 Victoria Crescent Road, Glasgow, W. 2	
1874	C. K. V. J.	Muir, Sir Thomas, C.M.G., M.A., D.Sc., LL.D., F.R.S., formerly Superintendent-General of Education for Cape Colony, Elmcote, Sandown Road, Rondebosch, South Africa	1885-88. V-P 1888-91.
1907		Muirhead, James M. P., J.P., F.R.S.L., F.S.S., "Carnel," Rouwkoop Road, Rondebosch, South Africa	
1928		* Murray, The Right Hon. Charles David, Lord Murray, P.C., C.M.G., K.C., M.A., LL.D., 62 Great King Street, Edinburgh	
1907	†	† Musgrove, James, M.D., F.R.C.S. (Edin. and Eng.), LL.D., Em. Professor of Anatomy, University of St Andrews. The Swallowgate, St Andrews	
1883		Napier, A. D. Leith, M.D., C.M., M.R.C.P., Hampton Street, Hawthorne, Unley, S. Australia	
1897		Nash, Hon. Alfred George, M.L.C., B.Sc., F.R.G.S., C.E., Belretiro, Mandeville, Jamaica, W.I.	
1924		* Nelson, Philip, M.A., M.D., Ch.B., Ph.D., F.S.A., Beechwood, Calderstones, Liverpool	
1893		Newman, Sir George, K.C.B., M.D., D.C.L., LL.D., F.R.C.P., Chief Medical Officer of the Ministry of Health and the Board of Education, Whitehall, London, S.W. 1	
1926		* Nichols, James Edward, M.Sc. (Dunelm), Ph.D. (Edin.), c/o British Research Association for the Woollen and Worsted Industries, Torridon, Headingley, Leeds	
1927		* Noble, Thomas Paterson, M.D. (Edin.), F.R.C.S. (Eng.), 2 Roxburgh Street, Galashiels	
1925		* Novar, The Right Hon. The Viscount, P.C., G.C.M.G., LL.D., Raith, Kirkcaldy	
1928	C.	* O'Donoghue, Charles Henry, D.Sc. (Lond.), Reader in Zoology in the University of Edinburgh. 24 Marchhall Crescent, Edinburgh	
1925		* Ogg, William Gammie, M.A., B.Sc., Ph.D., Advisory Officer in Soil Chemistry, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh	
1923	C.	* Ogilvie, Alan G., M.A., B.Sc. (Oxon.), Lecturer in Geography in the University of Edinburgh. 40 Fountainhall Road, Edinburgh	
1888	†	† Ogilvie, Sir F. Grant, Kt., C.B., M.A., B.Sc., LL.D., Principal Assistant Secretary, Department of Scientific and Industrial Research, Dewdney, Shere, Guildford	1901-03.
1929		* Ogilvie, Frederick Wolff, M.A., Professor of Political Economy, University of Edinburgh. 20 Murrayfield Gardens, Edinburgh	
1886		Oliver, James, M.D., F.L.S., Physician to the London Hospital for Women, 128 Harley Street, London, W.	
1895	C.	† Oliver, Sir Thomas, Kt., M.D., LL.D., F.R.C.P., Em. Professor of Physiology in the University of Durham, 7 Ellison Place, Newcastle-upon-Tyne	

Date of Mention.			Service on Council, etc.
1930		* Oliver, William, B.Sc., A.M.I.C.E., Professor of Organisation of Industry and Commerce, University of Edinburgh, and Director of Mitchell Graham & Sons, Ltd., Electrical and Mechanical Engineers, 70 Netherby Road, Trinity, Edinburgh	
1930		* O'Riordan, George Francis, B.Sc.(Eng.), M.Inst.Mech.E., Principal of Battersea Polytechnic, London, S.W. 7. Hesselwood, Cambalt Road, Putney Hill, London, S.W. 15	
1924		* Orr, John Boyd, D.S.O., M.C., M.A., D.Sc., M.D., Director of Rowett Research Institute for Research in Animal Nutrition. Research Lecturer in Physiology of Nutrition in the University of Aberdeen	
1915		* Orr, Lewis P., F.F.A., Manager of Scottish Life Assurance Co., 19 St Andrew Square, Edinburgh. 8 Belgrave Place, Edinburgh	
1927		* Owen, William John, Memb. Roy. Soc. Victoria. c/o Australian Institute of Anatomy, Canberra, F.C.T., Australia	
1908		Page, William Davidge. (Address not known)	
1906		Pallin, Lt.-Col. William Alfred, C.B.E., D.S.O., F.R.C.V.S., (retired), 5 Tower Gardens, Hythe, Kent.	
1924		* Parker, Joseph, D.Sc., Principal, Fife Mining School, Cowdenbeath. 128 Stenhouse Street, Cowdenbeath	
1901		Paterson, David, F.C.S., Leewood, Rosslyn Castle, Midlothian	
1918		* Paterson, Rev. William Paterson, D.D., LL.D., Professor of Divinity, University, Edinburgh. 39 George Square, Edinburgh	
1927		* Patterson, Charles, M.Inst. Marine Engineers; Lecturer in Mechanical Engineering Design and Theory of Machines, University of Edinburgh. 22 Dudley Terrace, Trinity, Edinburgh	
1919	C.	* Patterson, Thomas Stewart, D.Sc.(London and Glasgow), Ph.D.(Heidelberg), Professor of Organic Chemistry in the University of Glasgow. 89 Oakfield Avenue, Hillhead, Glasgow, W.2	
1926		* Patton, Donald, M.A., B.Sc., Ph.D., Lecturer in Botany, Glasgow Provincial College for the Training of Teachers. 15 Jordanhill Drive, Glasgow, W. 3	
1892		Paulin, Sir David, Actuary, 6 Forres Street, Edinburgh	
1923		* Peacock, Alexander David, D.Sc., Professor of Zoology, University College, Dundee	
1907		* Pearce, John Thomson, B.A., B.Sc., School House, Tranent	
1914		Pearson, Joseph, D.Sc., F.L.S., Director of the Colombo Museum, and Marine Biologist to the Ceylon Government, Colombo Museum, Ceylon	
1904		Peck, James Wallace, C.B., M.A., Second Secretary, Scottish Education Department, Dover House, Whitehall, London, S.W. 1	1926-28.
1887	C. M.B.	Pедdie, Wm., D.Sc., Professor of Natural Philosophy in University College, Dundee. The Weisha, Ninewells, Dundee	1904-07. 1908-11. V-P 1919-22.
1925		* Pennman, David, D.Sc., M.Inst.M.E., Principal Dhanbad School of Mines, India. Mines Department, Dhanbad, East Indian Railway, India	
1928		* Percival, George Hector, M.B., M.R.C.P.(Edin.), Ph.D., Assistant Physician, Skin Department, Royal Infirmary, Edinburgh. 17 Atholl Crescent, Edinburgh	
1893		Perkin, Em. Professor Arthur George, D.Sc., F.R.S., F.I.C., Grosvenor Lodge, Hyde Park, Leeds	
1913	C.	† Philip, Alexander, M.A., LL.B., Writer, The Mary Acre, Brechin	
1889		† Philip, Sir Robert William, Kt., M.A., M.D., LL.D., F.R.C.P.E., Professor of Tuberculosis, University of Edinburgh. 45 Charlotte Square, Edinburgh	V-P 1927-30
1907	C.	† Phillips, Major Charles E. S., O.B.E., Castle House, Shooters Hill, Woolwich, S.E. 18	
1929		* Phillips, John Frederick Vicars, D.Sc., F.L.S., Deputy Director and Ecologist. Kondea Irangi, via Dodoma, Tanganyika Territory, Central Africa	
1928		* Pilcher, Robert Stuart, General Manager and Engineer, Manchester Corporation Tramways and Motors. 55 Piccadilly, Manchester	
1914		* Pilkington, Basil Alexander, "Kambla," Davidson's Mains	
1906		Pinkerton, Peter, M.A., D.Sc., LL.D., Rector, High School, Glasgow. 7 Park Quadrant, Glasgow, C. 3	
1908	C.	* Pirie, James Hunter Harvey, B.Sc., M.D., F.R.C.P.E., Research Pathologist and Bacteriologist, The South African Institute for Medical Research. P.O. Box 1038, Johannesburg, South Africa	
1911		* Pirie, James Simpson, M.Inst.C.E., 25 Grange Road, Edinburgh	
1906		Pitchford, Herbert Watkins, C.M.G., F.R.C.V.S., Lt.-Col., Victoria Club, Pietermaritzburg, South Africa	

# Alphabetical List of the Ordinary Fellows of the Society. 395

Date of Election.		Service on Council, etc.
1924	* Ponder, Eric, M.D., D.Sc., Professor of General Physiology, Washington Square College, New York University, New York, U.S.A.	
1919	* Porritt, B. D., M.Sc. (Lond.), F.I.C., Director of Research, Research Association of British Rubber Manufacturers, 105-7 Lansdowne Road, Croydon, Surrey	
1888	† Prain, Sir David, Lt.-Col., Indian Medical Service (retired), C.M.G., C.I.E., M.A., M.B., LL.D., F.R.S., F.L.S., For. Memb. K. Svensk. Vetensk. Akad.; Hon. Memb. Soc. Lett. ed. Art. d. Zelanti, Acireale; Pharm. Soc. Gt. Britain; Corr. Memb. Bayer. Akad. Wiss., etc.; formerly Director, Royal Botanic Gardens, Kew, Surrey. The Well Farm, Warlingham, Surrey	
1926	* Prashad, Bainsi, D.Sc., Superintendent, Zoological Survey of India, Indian Museum, Calcutta	
1892	C. Pressland, Arthur J., M.A. (Camb.), 28 Carlyle Road, Cambridge	
1928	Price, Charles Edward, J.P., formerly M.P. for Central Edinburgh, Hon. Freeman of the City of Edinburgh. 16 Rothessay Terrace, Edinburgh	
1915	† Price, Frederick William, M.D., M.R.C.P. (Edin.), Physician to the Royal Northern Hospital, London. 133 Harley Street, London, W.	
1911	Purdy, John Smith, D.S.O., M.D., C.M. (Aberd.), D.P.H. (Camb.), F.R.G.S., Town Hall, Sydney, N.S.W., Australia	
1920	C. * Purser, George Leslie, M.A. (Cantab.), F.Z.S., Lecturer in Embryology, University of Aberdeen	
1898	Purves, John Archibald, D.Sc., Chilliswood, Trull, Taunton	
1899	C. Ramage, Alexander G., Lochcote, Linlithgowshire	
1904	Ratcliffe, Joseph Riley, M.B., C.M., c/o The Librarian, The University, Birmingham	
1900	Raw, Nathan, C.M.G., M.D., 30 Clarendon Court, Maida Vale, London, W.9	
1927	C. * Read, Herbert Harold, D.Sc. (Lond.), A.R.C.Sc., F.G.S., Senior Geologist, H.M. Geological Survey, Scotland, 19 Grange Terrace, Edinburgh	
1929	* Read, Selwyn, B.A., Schoolmaster, Edinburgh Academy. 2 Oxford Terrace, Edinburgh	
1902	Rees-Roberts, John Vernon, M.D., D.Sc., D.P.H., 90 Fitzjohns Avenue, Hampstead, London, N.W.3	
1918	Reid, Harry Avery, O.B.E., F.R.C.V.S., D.V.H., Bacteriologist and Pathologist, Department of Agriculture, Wellington, New Zealand, c/o Bank of New Zealand, 1 Queen Victoria Street, London, E.C.	
1924	* Reid, William Carstairs, Civil Engineer, 23 Saxe-Coburg Place, Edinburgh	
1914	Renshaw, Graham, M.D., M.R.C.S., L.R.C.P., L.S.A., Editor of the <i>Agricultural Magazine</i> , Sale Bridge House, Sale, Manchester	
1913	* Richardson, Major Harry, M.Inst.E.E., M.Inst.M.E., 16 Stratford Place, London, W.1	
1908	Richardson, Lindsay, F.G.S., 10 Oxford Parade, Cheltenham, Glos.	
1875	Richardson, Ralph, W.S., 2 Parliament Square, Edinburgh	
1927	* Ritchie, James Ernest, B.A., B.A.1., Trinity College, Dublin, F.G.S., District Geologist, H.M. Geological Survey, Scotland. 19 Grange Terrace, Edinburgh	
1930	* Ritchie, Allan Watt, Chief Sanitary Inspector of the City of Edinburgh. 2 Queensferry Terrace, Edinburgh	
1916	C. * Ritchie, James, M.A., D.Sc. (SECRETARY TO Ordinary Meetings), Regius Professor of Natural History in the University of Aberdeen	1921-24. 1926-28. Sec. 1928-
1914	C. * Ritchie, James Bonnyman, D.Sc., Head Master, Academy, Forres	
1906	C. Ritchie, William Thomas, M.D., F.R.C.P.E., Professor of Medicine in the University of Edinburgh. 10 Douglas Crescent, Edinburgh	
1929	* Robb, Richard Alexander, M.A., B.Sc., M.Sc., Lecturer in Mathematics, University of Glasgow. 19 Seyton Avenue, Langside, Glasgow, S.1.	
1898	C. Roberts, Hon. Alexander William, D.Sc., F.R.A.S., Lovedale, South Africa	
1919	* Roberts, Alfred Henry, O.B.E., M.Inst.C.E., Superintendent and Engineer, Leith Docks. 40 Buckingham Terrace, Edinburgh	
1926	* Roberts, John Alexander Fraser, M.A. (Cantab.), B.Sc., British Research Association for the Woollen and Worsted Industry, Leeds. 13 Liffon Place, Leeds	
1928	C. * Roberts, Owen Fienes Temple, M.C., M.A. (Camb.), Lecturer in Astronomy and Meteorology in the University of Aberdeen. 20 Belgrave Terrace, Aberdeen	
1902	C. Robertson, Robert A., M.A., B.Sc., Professor of Botany in the University of St Andrews	
1919	* Robertson, William Alexander, F.F.A., Century Insurance Co., Ltd., 18 Charlotte Square. Kilmarnock, Barnshot Road, Colinton	



Date of Election.			Service on Council, etc.
1896	C.	Robertson, W. G. Aitchison, D.Sc., M.D., F.R.C.P.E., St Margarets, St Valerie Road, Bournemouth	
1910	C. N.	* Robinson, Arthur, M.D., M.R.C.S., Professor of Anatomy, University of Edinburgh. 35 Coates Gardens, Edinburgh	1910-12. Sec. 1912-18. V.P. 1918-21.
1926		* Romanis, William Hugh Cowie, M.A., M.B., M.C. (Cantab.), F.R.C.S. (Eng.), Surgeon to St Thomas's Hospital, London, etc. 120 Harley Street, London, W.1	
1916		* Ronald, David, M.Inst.C.E., Chief Engineer, Scottish Board of Health, 125 George Street, Edinburgh	
1909	C.	* Ross, Alex. David, M.A., D.Sc., F.R.A.S., Professor of Mathematics and Physics, University of Western Australia, Perth, Western Australia	
1921		* Ross, Edward Burns, M.A. (Edin. and Camb.), Professor of Mathematics in the Madras Christian College, Madras	
1906		Russell, Alexander Durie, B.Sc., Mathematical Master, Falkirk High School. 14 Hough Street, Falkirk	
1930		Russell, David, LL.D., Paper Manufacturer. Silverburn, Leven, Fife	
1902	C. K.	Russell, James, 22 Glenorchy Terrace, Edinburgh	
1925	C.	* Saddler, William, M.A., B.A., Professor of Mathematics, Canterbury College, Christchurch, N.Z.	
1906		Saleeby, Caleb Williams, M.D., 13 Greville Place, Hampstead, London, N.W. 6	
1916	C.	* Salvesen, The Rt. Hon. Lord, P.C., K.C., LL.D., Judge of the Court of Session (retired), Dean Park House, Edinburgh	1920-22. V.P. 1922-25.
1914		* Salvesen, Theodore Emile, 37 Inverleith Place, Edinburgh	

# Alphabetical List of the Ordinary Fellows of the Society. 397

Date of Election.		Service on Council, etc.
1900	C. N. Sharpey-Schafer, Sir Edward Albert, M.D., D.Sc., LL.D., F.R.S. (PRESIDENT), Corresponding Member of the French Academy of Medicine, Professor of Physiology in the University of Edinburgh	1900-03, 1906-09, 1918-19. V-P 1913-17. P 1929-
1927	* Sharpley, Forbes Wilmot, B.Sc. (Eng.) (Lond.), A.M.I.E.E., Professor of Electrical and Mechanical Engineering, Indian School of Mines, Dhanbad, Bihar and Orissa, India	
1927	* Shearer, Ernest, M.A., B.Sc. (Edin.), Professor of Agriculture and Rural Economy, Edinburgh University, and Principal of the Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh	
1908	* Simpson, George Freeland Barbour, M.D., F.R.C.P.E., F.R.C.S.E., J.P., 43 Manor Place, Edinburgh	
1900	C. † Simpson, James Young, M.A., D.Sc., Professor of Natural Science in the New College, Edinburgh. 25 Chester Street, Edinburgh	1922-25
1900	Sinhjee, Sir Bhagvat, G.C.I.E., M.D., LL.D. (Edin.), H.H. the Thakur Sahib of Gondal, Gondal, Kathiawar, Bombay, India	
1903	† Skinner, Robert Taylor, M.A., J.P., Head Master, Donaldson's Hospital, Edinburgh	
1930	C. * Slater, Robert Henry, B.Sc., Ph.D. (Edin.), Research Chemist, 4 Kingsburgh Road, Murrayfield, Edinburgh	
1929	* Smail, James Cameron, Assoc.Inst.E.E., Principal, Heriot-Watt College, Edinburgh. 1 Grange Terrace, Edinburgh	
1926	* Small, James, D.Sc., Ph.C., Professor of Botany, Queen's University, Belfast. Ardcolm, Knock, Belfast	
1901	Smart, Edward, B.A., B.Sc., Tillygloss, Tullylumb Terrace, Perth	
1920	* Smellie, William Robert, M.A., D.Sc., Geologist on the Staff of the Anglo-Persian Oil Company. Ardene, Mossend, Lanarkshire	
1928	Smith, Alice Drummond Buchanan, M.A., B.Sc. (Agric.) (Aberd.), M.S.A. (Iowa), Lecturer, Animal Breeding Research Department, University of Edinburgh	
1915	* Smith, James Lorrain, M.A., Hon. D.Sc., M.D., LL.D., F.R.S., Professor of Pathology, University of Edinburgh. 8 Cobden Crescent, Edinburgh	1918-21.
1921	* Smith, Norman Kemp, M.A., D.Phil., D.Litt., LL.D., Professor of Logic and Metaphysics, University of Edinburgh. Ellerton, Grange Loan, Edinburgh	
1923	* Smith, Percy James Lancelot, M.A. (Oxon.), F.I.C., F.C.S., Science Master, Loretto School. 47 Dalrymple Loan, Musselburgh	
1911	* Smith, Stephen, B.Sc., Engineer, 31 Grange Loan, Edinburgh	
1929	* Smith, Sydney, M.D., F.R.C.S., Professor of Forensic Medicine, University of Edinburgh. 10 Oswald Road, Edinburgh	
1907	C. † Smith, William Ramsay, D.Sc., M.D., C.M., Permanent Head of the Health Department, South Australia, Belair, South Australia	
1880	Smith, Sir William (Robert), M.D., D.Sc., LL.D., Principal of The Royal Institute of Public Health, Em. Professor of Forensic Medicine and Toxicology in King's College, University of London. 36 Russell Square, London, W.C.1	
1919	* Smith, William Wright, M.A., D. & Sc. (VICE-PRESIDENT), Regius Professor of Botany, University of Edinburgh, Regius Keeper of the Royal Botanic Garden, and King's Botanist in Scotland. Inverleith House, Edinburgh	Sec. 1923-28. V-P 1928-
1899	Snell, Ernest Hugh, M.D., B.Sc., D.P.H. Camb., Medical Officer of Health, Coventry. 8 Eaton Road, Coventry	
1880	Sollas, William Johnson, M.A., D.Sc., LL.D., F.R.S., Fellow of University College, Oxford, and Professor of Geology and Palaeontology in the University of Oxford	
1910	* Somerville, Robert, B.Sc., Lindrum, Queensferry Road, Dunfermline	
1899	† Somerville, Sir Wm., K.B.E., M.A., D.Sc., D.Oec., formerly Sibthorpean Professor of Rural Economy and Fellow of St John's College in the University of Oxford. Rye House, Foxcombe Hill, near Oxford	
1911	C. * Sommerville, Duncan McLaren Young, M.A., D.Sc., Professor of Pure and Applied Mathematics, Victoria College, Wellington, New Zealand	
1929	* Southwell, Thomas, D.Sc., A.R.C.S., Lecturer in Helminthology, School of Tropical Medicine, Liverpool. 8 Waverley Road, Sefton Park, Liverpool	
1925	* Staig, Robert Arnot, M.A., Lecturer in Zoology in the University of Glasgow. Glenlea, Lasswade, Midlothian	

Date of Election.			Service on Council, etc.
1891		Stanfield, Richard, A.R.S.M., M.Inst.C.E., formerly Professor of Mechanics and Engineering in the Heriot-Watt College, Edinburgh. 24 Mayfield Gardens, Edinburgh	1926-29.
1923		*Stebbing, Edward Percy, M.A., Professor of Forestry in the University of Edinburgh	
1885		*Steggall, John Edward Aloysius, M.A., Hon. A.R.I.B.A., Professor of Mathematics at University College, Dundee (St Andrews University). Woodend, Perth Road, Dundee	
1915		*Stenhouse, Andrew G., F.G.S., 191 Newhaven Road, Leith	
1923		*Stephen, Alexander Charles, B.Sc., Assistant, Natural History Department, Royal Scottish Museum, Edinburgh. "Eastercroft," Cramond Bridge, Edinburgh	
1929	C.		
1912	O. K.	† Stephenson, John, C.I.E., M.B., D.Sc. (Lond.), F.R.S., Lt.-Col. I.M.S. (retired), British Museum (Natural History), Cromwell Road, London, S.W. 7. 42 Orsett Terrace, London, W. 2	
1910		*Stephenson, Thomas, D.Sc., F.C.S., Editor of the <i>Prescriber</i> , 13 Glencairn Crescent, Edinburgh	
1925		*Stevens, Alexander, M.A., B.Sc., Lecturer in Geography in the University of Glasgow	
1886	C.	Stevenson, Charles A., B.Sc., M.Inst.C.E., 28 Douglas Crescent, Edinburgh	
1884		† Stevenson, David Alan, B.Sc., M.Inst.C.E., Troqueur, Kingsknowe, Colinton, Midlothian	1928-
1919		*Stevenson, David Alan, B.Sc., M.Inst.C.E., 22 Glencairn Crescent, Edinburgh	
1925		*Stewart, David Smith, B.Sc., Ph.D., Assoc. M.Inst.C.E., Lecturer on Structural Engineering Drawing in the University of Edinburgh. 12 Lasswade Road, Liberton, Edinburgh	
1924		*Stiles, Sir Harold Jalland, K.B.E., M.B., F.R.C.S.E., LL.D., formerly Professor of Clinical Surgery in the University of Edinburgh. Whetton Lodge, Gullane, E. Lothian	
1902		Stockdale, Herbert Fitton, LL.D., Director of the Royal Technical College, Glasgow. Clairinch, Upper Helensburgh, Dumbartonshire	
1889	C.	Stockman, Ralph, M.D., LL.D., F.R.C.P.E., F.F.P.S.G., Professor of Materia-Medica and Therapeutics in the University of Glasgow	1903-05.
1926		*Stokoe, William Norman, B.Sc., Ph.D. (Lond.), Chief Chemist and Works Manager, Cragmillar Creamery Co., Ltd. 67 Inchview Terrace, Edinburgh	
1906		Story, Fraser, formerly Professor of Forestry, University College, Bangor, North Wales. 4K Artillery Mansions, Victoria Street, London, S.W. 1	
1907		*Strong, John, C.B.E., M.A., LL.D. Professor of Education in the University of Leeds. Devonshire Hall, Headingley, Leeds	
1930		*Struthers, John William, M.B., Ch.B., F.R.C.S.E., Secretary and Treasurer, Royal College of Surgeons, Edinburgh, Surgeon to the Royal Infirmary, Edinburgh. 15 Ainslie Place, Edinburgh	
1930	C.	*Stump, Claude Witherington, M.D., D.Sc., Professor of Embryology and Histology in the University of Sydney	
1903		Sutherland, David W., C.I.E., M.D., M.R.C.P., Lt.-Col. I.M.S. (retired), Braeside, Belhaven, Dunbar	
1930		*Sutherland, John Donald, C.B.E., LL.D., F.S.I., Chevalier of the Legion of Honour (France), Assistant Commissioner, Forestry, Scotland. 11 Inverleith Row, Edinburgh	
1925		Sutton, Richard L., M.D., D.Sc., LL.D., Professor of Diseases of the Skin in the University of Kansas School of Medicine, U.S.A.	
1917	C. N.	*Tait, John, D.Sc., M.D., Professor of Physiology, McGill University, Montreal, Canada	
1904		Tait, John W., B.Sc., formerly Rector of Leith Academy, Netherby, Pitkeathly, Bridge of Earn	
1895		† Talmage, James Edward, D.Sc., Ph.D., F.R.M.S., F.G.S., formerly Professor of Geology, University of Utah. 47 East S. Temple Street, Salt Lake City, Utah, U.S.A.	
1890	C.	† Tanakadate, Aikitu, Hon. Professor of Natural Philosophy in the Imperial University of Japan. Koisikawa, Zōsigayamati, 144, Tokyo, Japan	
1870		Tatlock, Robert R., F.C.S., City Analyst's Office, 156 Bath Street, Glasgow	
1899		Taylor, James, M.A., formerly Mathematical Master in the Edinburgh Academy. 18 Hillview, Blackhall, Edinburgh	
1917	C.	*Taylor, William White, M.A., D.Sc., Lecturer on Chemical Physiology, University, Edinburgh. Park Villa, Liberton, Edinburgh	
1892		Thackwell, J. B., M.B., C.M., D.P.H., 423A Battersea Park Road, London, S.W. 11	

# Alphabetical List of the Ordinary Fellows of the Society. 399

Date of Election.			Service on Council, etc.
1885	O.	Thompson, D'Arcy Wentworth, C.B., M.A., D.Sc., D.Litt., F.R.S., Foreign Hon. Member Amer. Acad. Arts and Sciences (CURATOR OF LIBRARY AND MUSEUM), Professor of Natural History, University, St Andrews. 44 South Street, St Andrews	1892-95, 1896-99, 1907-10, 1912-15, 1922-25. V.P. 1916-19. Curator 1926-
1917	C. N.	* Thompson, John M'Lean, M.A., D.Sc., F.L.S., Professor of Botany, University of Liverpool	
1896		Thomson, George Ritchie, C.M.G., M.B., C.M., Professor of Surgery, University College, Johannesburg, Transvaal	
1903		Thomson, George S. (Address not known)	
1906		Thomson, Gilbert, M.A., M.Inst.C.E., 164 Bath Street, Glasgow, C.2	
1926		* Thomson, Godfrey Hilton, D.Sc., Ph.D., Professor of the Theory, History, and Practice of Education in the University of Edinburgh	
1887	C.	Thomson, Sir J. Arthur, M.A., LL.D., Em. Regius Professor of Natural History in the University of Aberdeen. St Mary's Lodge, Limpsfield, Surrey	1906-08, 1920-23.
1906	C.	Thomson, James Stuart, M.Sc., Ph.D., 5 Chesterton Terrace, Cirencester, Gloucestershire	
1926	C.	* Thomson, John, M.A., B.Sc., Ph.D. (Glasg.), Lecturer in Plant Physiology in the University of Glasgow. 2 Chartwell Terrace, Bearsden, Glasgow	
1880		Thomson, John Millar, LL.D., F.R.S., Hon. Fellow King's College and Queen's College, London. 6 Doro Place, Kensington, London, W. 8	
1899		Thomson, R. Tatlock, F.C.S., 156 Bath Street, Glasgow	
1912	C.	Thomson, Robert Black, M.B. (Edin.), Aliwal North, Cape Province, S.A.	
1870		Thomson, Spencer C., Actuary, 10 Eglinton Crescent, Edinburgh	
1882		Thomson, Sir William, Kt., M.A., B.Sc., LL.D., formerly Principal, University of the Witwatersrand. Dunedin, Glencairn, Simonstown, South Africa	
1917		* Thorneycroft, Wallace, J.P., Strete Raleigh, Whimble, Exeter, Devon	
1920		* Todd, John Barber, B.Sc., Ph.D., M.I.Mech.E., Lecturer in Engineering in the University of Edinburgh. 98 Findhorn Place, Edinburgh	
1917		* Tovey, Donald Francis, B.A. (Oxon.), M.Mus. (Hon.), Birmingham, Professor of Music, University, Edinburgh. 18 Buccleuch Place, Edinburgh	
1914		+ Tredgold, Alfred Frank, M.D. (Durham), F.R.C.P. (Lond.), Lecturer on Mental Deficiency at London University, and Bethlem Royal Hospital, "St Martins," Guildford	
1915		* Trotter, George Clark, M.D., Ch.B. (Edin.), D.P.H. (Aberdeen), Medical Officer of Health, Metropolitan Borough, Islington. Braemar, 17 Haslemere Road, Crouch End, London, N. 8	
1922	C. K.	* Turnbull, Herbert Westren, M.A., Professor of Mathematics in the University of St Andrews. 2 Queens Terrace, St Andrews	1928-
1905		Turner, Arthur Logan, M.D., L.B.D., F.R.C.S.E., (VICE-PRESIDENT), 27 Walker Street, Edinburgh	1926-29. V.P. 1930-
1925		* Turner, Harry Moreton Stanley, M.B.E., M.D., M.R.C.S., L.R.C.P., D.T.M. and H., Chevalier de l'Ordre Royale du Sauveur de Grèce. Wing-Commander, Royal Air Force Medical Service, Headquarters, Fighting Area, Royal Air Force, Hillingdon House, Uxbridge. 56 Nicholls Avenue, Hillingdon Heath, Uxbridge	
1924		* Turner, Richard, O.B.E., M.B., C.M., Hotel Hydropathic, Peebles	
1895		Turton, Albert H., M.I.M.M., 233 George Road, Erdington, Birmingham	
1918	C.	* Tyrrell, G. W., A.R.C.Sc., Ph.D., F.G.S., Chief Assistant and Lecturer in Petrology, Geological Department, University, Glasgow	1926-29.
1910		Vincent, Swale, M.D. (Lond.), D.Sc. (Edin.), Professor of Physiology in the University of London. 15 Fishpool Street, St Albans, Herts	
1920	C.	* Voge, Cecil Innes Bothwell, B.Sc., Ph.D. (Edin.), Research Chemist. Eden Lodge, Eden Lane, Edinburgh	
1926		* Wakeley, Cecil Pembrey Grey, F.R.C.S. (Eng.), Lecturer in Anatomy, King's College, London. 24 Queen Anne Street, Cavendish Square, London, W. 1	
1925	C.	* Walker, Fred., M.A., Ph.D., D.Sc., Lecturer in Geology, University, St Andrews	
1891	C. M.B.	Walker, Sir James, Kt., D.Sc., Ph.D., LL.D., F.R.S., formerly Professor of Chemistry in the University of Edinburgh. 5 Wester Coates Road, Edinburgh	1903-05, 1910-13, 1922-25. 1926- V.P. 1916-19.

Date of Election.			Service on Council, etc.
1902			
1886	C.	Wallace, Alexander G., M.A., 56 Fonthill Road, Aberdeen	
		Wallace, Robert, M.A., LL.D., F.L.S., Em. Professor of Agriculture and Rural Economy in the University of Edinburgh. c/o Mrs M'Call, 11 Bruntsfield Crescent, Edinburgh	
1898		Wallace, Wm., M.A., Campsie, Alta, Canada	
1920		* Walmsley, Thomas, M.D. (Glasg.), Professor of Anatomy, Queen's University, Belfast	
1927	C.	* Wardlaw, Claude Wilson, B.Sc., Ph.D. (Glasg.), Imperial College of Tropical Agriculture and Imperial Department of Agriculture, Trinidad, West Indies	
1923		* Warren, John Alexander, M.Inst.C.E., M.Cons.E. (Westminster). 74 Balahagray Avenue, Partick	
1901	O.	Waterston, David, M.A., M.D., F.R.C.S.E., Professor of Anatomy, University, { St Andrews	1916-19. 1925-26.
1927		* Watson, Charles Brodie Boag, F.S.A.Scot., 24 Garscube Terrace, Edinburgh	
1923		* Watson, H. Ferguson, M.D., F.R.F.P.S., Ph.D., D.P.H. (Glasg.), H.M. Senior Deputy Commissioner, General Board of Control for Scotland. 25 Palmerston Place, Edinburgh	
1911		* Watson, James A. S., M.C., B.Sc., etc., Sibthorpe Professor of Rural Economy in the University of Oxford. School of Rural Economy, Parks Road, Oxford	
1900		Watson, Thomas P., M.A., B.Sc., Principal, Trade and Grammar School, Keiglinley	
1923	C.	* Watson, William, M.A. (Edin.), B.Sc. (Edin.), Lecturer in Physics, Heriot-Watt College, Edinburgh. 17 Braidburn Crescent, Edinburgh	
1911		† Watt, James, W.S., F.F.A., LL.D. (TREASURER), Craiglockhart House, { Craiglockhart Avenue, Edinburgh, W.	1924-26. Treasurer 1926-
1911		* Watt, Rev. Lauchlan Maclean, M.A., D.D., Minister of Glasgow Cathedral. 1 Athole Gardens, Glasgow	
1928		* Watters, Alexander Marshall, M.A., B.Sc. (Glasg.), Rector of Hawick High School. High School House, Hawick	
1896		† Webster, John Clarence, B.A., M.D., F.R.C.P.E., Professor of Obstetrics and Gynaecology, Rush Medical College, Shediac, N.B., Canada	
1907	M.H.	* Wedderburn, Ernest MacLagan, M.A., LL.B., W.S., D.Sc., Professor of Con- {	1913-16, 1921-24
1903	C.	veyancing in the University of Edinburgh. 6 Succoth Gardens, Edinburgh {	
	M.H.	† Wedderburn, J. H. MacLagan, M.A., D.Sc., P.O. Box 53, Princeton, N.J., U.S.A.	
1904	C.	Wedderspoon, William Gibson, M.A., LL.D., Indian Educational Service, Senior Inspector of Schools, Burma. The Education Office, Rangoon, Burma	
1930		* White, Adam Cairns, M.B., Ch.B., Ph.D., Assistant Pharmacologist, Wellcome Physiological Research Laboratory, Beckenham, Kent	
1911		* Whittaker, Charles Richard, F.R.C.S. (Edin.), F.S.A.Scot., Lynwood, Hatton Place, Edinburgh	
1912	C.	* Whittaker, Edmund Taylor, M.A., Hon. Sc.D. (Dubl.), LL.D., F.R.S., {	1912-15, 1922-25.
	V. J.	Foreign Member of the R. Accademia dei Lincei, Rome, Professor { of Mathematics in the University of Edinburgh. 48 George Square, Edinburgh	Sec. 1915-22. V.P 1925-28.
1928	C.	* Whittaker, John Macnaghten, M.A. (Edin.), B.A. (Camb.), D.Sc., Fellow and Lecturer of Pembroke College, Cambridge	
1918		* Whyte, Rev. Charles, M.A., LL.D., F.R.A.S., U.F. Church Manse, Kingswells, Aberdeen	
1929	C.	* Wiesner, Bertold Paul, Ph.D., Lecturer in Sex Physiology, Animal Breeding Research Department, University of Edinburgh	
1918		* Wight, John Thomas, M.I.Mech.E., General Manager, Messrs MacTaggart, Scott & Co., Ltd., Station Iron Works, Loanhead. Calderwood Villa, Lasswade	
1925		* Wilkie, David Percival Dalbreck, O.B.E., M.D., Ch.M., F.R.C.S., Professor of Surgery in the University of Edinburgh. 9 Ainslie Place, Edinburgh	
1926	C.	* Williams, Samuel, M.Sc., Ph.D., Lecturer in Plant Morphology in the University of Glasgow. 27 Lindsay Place, Kelvindale, Glasgow	
1924		* Williams, William Arthur, F.I.C., 1 Lennox Street, Edinburgh	
1908		* Williamson, Henry Charles, M.A., D.Sc., formerly Naturalist to the Fishery Board for Scotland, Marine Laboratory, Aberdeen. 13 Couper Street, Dundee	
1928	C.	* Williamson, John, M.A. (Edin.), Ph.D. (Chicago), Associate Professor of Mathematics in Johns Hopkins University, Baltimore, U.S.A.	

# Alphabetical List of the Ordinary Fellows of the Society. 401

Date of Election.			Service on Council, etc.
1910	O.	* Williamson, William, F.L.S., 7 Ventnor Terrace, Edinburgh	
1927	C.	* Williamson, William Turner Horace, B.Sc. (Aberd.), Ph.D. (Edin.), Chief Chemist, Egyptian Ministry of Agriculture, Cotton Research Board, Giza, Cairo, Egypt	
1900		Wilson, Alfred C., Bloomfield House, Sadberge, near Darlington	
1911		* Wilson, Andrew, M.Inst.C.E., 66 Netherby Road, Trinity, Edinburgh	
1902	V. J.	+ Wilson, Charles T. R., M.A., LL.D., F.R.S., Nobel Prize, Physics, 1927, Jacksonian Professor of Natural Philosophy in the University of Cambridge. Glencorse, Storey's Way, Cambridge	
1922		* Wilson, John, F.R.I.B.A., Fellow of the Inst. of Scottish Architects. Chief Architect, Scottish Department of Health. 20 Lomond Road, Edinburgh	
1920	C.	* Wilson, Malcolm, D.Sc. (London), A.R.C.Sc., F.L.S., Reader in Mycology and Bacteriology in the University of Edinburgh. Brent Knoll, Kinnear Road, Edinburgh	
1924		* Wilson, William, M.A., LL.B., Advocate, Regius Professor of Public Law in the University of Edinburgh. 38 Moray Place, Edinburgh	
1895		Wilson-Barker, Sir David, Kt., R.D., R.N.R., F.R.G.S., formerly Captain-Superintendent Thames Nautical Training College, H.M.S. "Worcester." 22 Redcliffe Gardens, London, S.W. 10	
1922	C. B.	* Wordie, James Mann, M.A. (Camb.), B.Sc. (Glasg.), 52 Montgomery Drive, Glasgow, and St John's College, Cambridge	
1890		Wright, Johnstone Christie, Conservative Club, Edinburgh	
1896		+ Wright, Sir Robert Patriok, LL.D., formerly Chairman of the Board of Agriculture for Scotland. Wenallt House, Crosswood, Cardiganshire	
1911	C.	* Wrigley, Ruric Whitehead, M.A. (Cantab.), Assistant Astronomer, Royal Observatory, Edinburgh	
1882		Young, Frank W., C.B.E., F.C.S., H.M. Inspector of Schools (Emeritus). 35 Pentland Terrace, Edinburgh	
1904		Young, R. B., M.A., D.Sc., F.G.S., Professor of Geology and Mineralogy in the South African School of Mines and Technology, Johannesburg, Transvaal	

Number of Ordinary Fellows, 704.

# LIST OF HONORARY FELLOWS OF THE SOCIETY.

(At 27th October 1930.)

HIS MOST EXCELLENT MAJESTY THE KING.  
HIS ROYAL HIGHNESS THE PRINCE OF WALES.

## FOREIGNERS (LIMITED TO THIRTY-SIX BY LAW I).

### Elected

- 1916 Charles Eugène Barrois, formerly Professor of Geology and Mineralogy, Université, Lille, France: 37, rue Pascal, Lille.
- 1923 Henri Bergson, Honorary Professor, Collège de France, Paris.
- 1930 Vilhelm Frimann Koren Bjerknes, Professor of Physics, Geophysical Institute, Bergen.
- 1927 Niels Bohr, Nobel Laureate, Physics, 1922, Professor of Physics, University of Copenhagen.
- 1927 Jules Bordet, Nobel Laureate, Medicine, 1919, Professor of Bacteriology, University of Brussels.
- 1923 Marcellin Boule, Professor at the National Museum of Natural History, Laboratory of Palaeontology, 3 Place Valhubert, Paris 5<sup>e</sup>.
- 1905 Waldemar Christofer Brögger, Professor of Mineralogy and Geology, K. Frederiks Universitet, Oslo, Norway.
- 1916 Douglas Houghton Campbell, Em.-Professor of Botany, Leland Stanford Junior University, California, U.S.A.
- 1920 William Wallace Campbell, President-Emeritus of the University of California, Berkeley, and Director-Emeritus of the Lick Observatory, Mt. Hamilton, California, U.S.A.
- 1930 Walter Bradford Cannon, Professor of Physiology, Harvard University, Cambridge, U.S.A.
- 1930 Maurice Caullery, Professor of Zoology in the University of Paris. Evolution des Etres Organises Laboratoire, 105 Bould. Raspail, Paris, VI<sup>e</sup>.
- 1921 Reginald Aldworth Daly, Professor of Geology, Harvard University, Cambridge, Mass.
- 1910 Hugo de Vries, Professor of Plant Anatomy and Physiology, Lunteren, Holland.
- 1927 Albert Einstein, Nobel Laureate, Physics, 1921, Professor of Mathematical Physics, University of Berlin.
- 1930 Giulio Fano, Professor of Physiology in the Royal University of Rome.
- 1916 Marcel Eugène Emile Gley, Professor of Biology, Collège de France, Paris, Membre de l'Académie de Médecine, Paris: 14, rue Monsieur le Prince, Paris.
- 1910 Karl Ritter von Goebel, Professor of Botany, Universität, München, Germany.
- 1913 George Ellery Hale, Honorary Director of Mount Wilson Observatory (Carnegie Institution of Washington), Pasadena, California, U.S.A.
- 1921 Johan Hjort, Professor of Marine Biology, University, Oslo.
- 1923 Arnold Frederik Holleman, Professor of Organic Chemistry, University, Amsterdam.
- 1923 Tullio Levi-Civita, Professor of Mathematics (Higher Analysis), University, Rome.
- 1927 Hans Horst Meyer, Emeritus Professor of Pharmacology, University of Vienna.
- 1910 Albert Abraham Michelson, Nobel Laureate, Physics, 1907, Professor of Physics, University, Chicago, U.S.A.
- 1923 Arthur Amos Noyes, Institute of California, Pasadena, U.S.A.
- 1908 Henry Fairfield Osborn, Research Professor of Zoology, Columbia University, and President, American Museum of Natural History, New York, U.S.A., Senior Geologist, U.S.A. Geological Survey.
- 1908 Ivan Petrovitch Pavlov, Em. Professor of Physiology, Inst. Exper. Med., Leningrad, Nobel Laureate, Physiology and Medicine, 1904: 7, Linia, No. 2, Vassilievsky, Ostrov, Leningrad, Russia.
- 1920 Ch. Emile Picard, Perpetual Secretary, Academy of Sciences, Paris.
- 1921 Salvatore Pincherle, Professor of Mathematics in the University of Bologna.
- 1913 Santiago Ramón y Cajal, Nobel Laureate, Medicine, 1906, formerly Professor of Histology and Pathological Anatomy, University, Madrid, Spain.
- 1920 Charles Richet, Professor of Physiology, Faculty of Medicine, Paris, Nobel Laureate, Medicine, 1913.
- 1927 Johannes Schmidt, A Director of the Carlsberg Laboratorium, Copenhagen.
- 1930 Erik Helge Oswald Stenstio, Professor of Mathematics in the University of Bologna.
- 1913 Vito Volterra, Professor of Mathematical Physics, Regia Università, Rome, Italy.
- 1927 Richard Willstätter, Professor of Chemistry, University of Munich, Nobel Laureate, Chemistry, 1915. Munich 27, Moehlstrasse 29.
- 1923 Edmund Beecher Wilson, Professor of Zoology, Columbia University, New York, U.S.A.

Total, 35.

## BRITISH SUBJECTS (LIMITED TO TWENTY BY LAW I).

## Elected

- 1927 Sir William Henry Bragg, K.B.E., M.A., D.Sc., LL.D., F.R.S., Fullerian Professor of Chemistry, Royal Institution, London. Nobel Laureate, Physics, 1915.
- 1927 Sir David Bruce, K.C.B., M.B., C.M., Hon. D.Sc., LL.D., F.R.S., Major-General and Colonel-Commandant, A.M.S. Lister Institute, Chelsea Gardens, London, S.W. 1.
- 1930 Sir Arthur Stanley Eddington, M.A., Hon. D.Sc., F.R.S., Plumian Professor of Astronomy and Experimental Philosophy in the University of Cambridge.
- 1927 Sir John Bretland Farmer, Kt., M.A., D.Sc., LL.D., F.R.S., Formerly Professor of Botany, Imperial College of Science and Technology, London.
- 1900 Andrew Russell Forsyth, M.A., Sc.D., LL.D., Hon. Math.D., F.R.S., Em. Professor of Mathematics in the Imperial College of Science and Technology, London; formerly Sadleirian Professor of Pure Mathematics in the University of Cambridge. Imperial College of Science and Technology, London, S.W. 7.
- 1910 Sir James George Frazer, O.M., Kt., D.C.L., LL.D., Litt.D., F.R.S., Commandeur de la Légion d'Honneur, Fellow of Trinity College, Cambridge.
- 1930 Sir William Bate Hardy, Kt., M.A., F.R.S., Director of Food Investigation, Department of Scientific and Industrial Research, 5 Grange Road, Cambridge.
- 1927 Sir Frederick Gowland Hopkins, Kt., M.A., M.B., D.Sc., LL.D., F.R.S., Joint Nobel Laureate, Medicine, 1929, Professor of Bio-Chemistry, University of Cambridge.
- 1930 Sir Arthur Keith, F.R.S., Hunterian Professor and Conservator of the Museum of the Royal College of Surgeons, London.
- 1913 Horace Lamb, M.A., Sc.D., D.Sc., LL.D., F.R.S., formerly Professor of Mathematics in the University of Manchester. 6 Selwyn Gardens, Cambridge.
- 1910 Sir Joseph Larmor, Kt., M.A., D.Sc., LL.D., D.C.L., F.R.S., Lucasian Professor of Mathematics in the University of Cambridge. St John's College, Cambridge.
- 1930 John Edward Marr, Sc.D., F.R.S., Fellow of St John's College, and Em. Professor of Geology, Cambridge. 126 Huntingdon Road, Cambridge.
- 1930 Robert Robinson, D.Sc., F.R.S., Waynflete Professor of Chemistry in the University of Oxford. The Dyson Perrins Laboratory, South Parks Road, Oxford.
- 1921 Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S., Nobel Laureate, Physiology and Medicine, 1902, Director in Chief, The Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W. 15. Hon. Consultant in Malaria, Ministry of Pensions, London.
- 1921 Sir Ernest Rutherford, O.M., Kt., M.A., D.Sc., B.A., LL.D., Pres. R.S., Nobel Laureate, Chemistry, 1908, Cavendish Professor of Experimental Physics in the University of Cambridge.
- 1916 Sir Arthur Schuster, Kt., Ph.D., D.Sc., LL.D., Dr ès Sc. Geneva, Honorary Professor of Physics in the University of Manchester. Yeldall, Twyford, Berks.
- 1930 Dukinfield Henry Scott, M.A., D.Sc., LL.D., Ph.D., F.R.S., lately Honorary Keeper of the Jodrell Laboratory, Royal Botanic Gardens, Kew. East Oakley House, Basingstoke, Hants.
- 1908 Sir Charles Scott Sherrington, O.M., G.B.E., M.A., D.Sc., M.D., LL.D., Past Pres. R.S., Waynflete Professor of Physiology in the University of Oxford. Physiological Laboratory, Oxford.
- 1905 Sir Joseph John Thomson, O.M., Kt., D.Sc., LL.D., Past Pres. R.S., Nobel Laureate, Physics, 1906, formerly Cavendish Professor of Experimental Physics, University of Cambridge, Master of Trinity College, Cambridge.

Total, 19.



## CHANGES IN FELLOWSHIP DURING SESSION 1929-1930.

### ORDINARY FELLOWS OF THE SOCIETY ELECTED.

WILLIAM ANNAN.  
DAVID RAITT ROBERTSON BURT.  
JOHN CUNNINGHAM.  
LEWIS MERSON DAVIES.  
ALEX. EBENEZER M'LEAN GEDDES.  
DOUGLAS GUTHRIE.  
SIR THOMAS HENRY HOLLAND.  
DAVID JACK.  
SAMUEL GRIFFITH JONES.  
PERCY SAMUEL LELAND.  
JAMES WOTHERSPOON LOW.  
ANDREW CORRIE M'CANDLISH.  
WILLIAM CHRISTOPHER MILLER.  
JOHN MILLER WOODBURN MORISON.

JAMES MORTON.  
WILLIAM OLIVER.  
GEORGE FRANCIS O'RIORDAN.  
ALLAN WATT RITCHIE.  
DAVID RUSSELL.  
FREDERICK WHALLEY SANSOME.  
ERNEST CLAUD SHANKLAND.  
ROBERT HENRY SLATER.  
JOHN WILLIAM STRUTHERS.  
CLAUDE WITHERINGTON STUMP.  
JOHN DONALD SUTHERLAND.  
CECIL INNES BOTHWELL VOGEL.  
ADAM CAIRNS WHITE.

### HONORARY FELLOWS ELECTED.

#### BRITISH HONORARY FELLOWS.

SIR ARTHUR STANLEY EDDINGTON.  
SIR WILLIAM BATE HARDY.  
SIR ARTHUR KEITH.

JOHN EDWARD MARR.  
ROBERT ROBINSON.  
DUKINFIELD HENRY SCOTT.

#### FOREIGN HONORARY FELLOWS.

VILHELM FRIMANN KOREN BJERKNES.  
WALTER BRADFORD CANNON.  
MAURICE CAULLERY.

GIULIO FANO.  
ERIK HELGE OSWALD STENSIÖ.

### ORDINARY FELLOWS DECEASED.

THE RT. HON. THE EARL OF BALFOUR.  
JOHN BUCKLEY BRADBURY.  
JOSEPH HENRY CARTER.  
GEORGE GOUDIE CHISHOLM.  
WALTER COLQUHOUN.  
DAVID CORRIE.  
SIR JOHN RITCHIE FINDLAY, BT.  
GEORGE ALEXANDER GIBSON.

RT. HON. THE EARL OF KINTORE.  
JAMES ALEX. GEORGE LAMB.  
SIR WM. SYMINGTON M'CORMICK.  
ROBERT MACKENZIE.  
SIR GEO. ARCHDALL O'BRIEN REID.  
ARCH. ADAM SCOT SKIRVING.  
ANDREW THOMSON.  
PHILIP JACOB WHITE.

### FOREIGN HONORARY FELLOW DECEASED.

FRIDTJOF NANSEN.

### ORDINARY FELLOWS RESIGNED.

REV. WM. STRATON BRUCE.  
HAROLD ROPER ROBINSON.

GEORGE PAGET THOMSON.  
R. VAIDYANATHASWAMY.

## LAWS OF THE SOCIETY.

*Adopted July 3, 1916 ; amended December 18, 1916.*

(Laws VIII, IX, and XIII amended May 3, 1920. Law VI amended February 7, 1921.  
Law XIX amended June 16, 1924. Law VI amended July 2, 1928.)

### I.

THE ROYAL SOCIETY OF EDINBURGH, which was instituted by Royal Charter in 1783 for the promotion of Science and Literature, shall consist of Ordinary Fellows (hereinafter to be termed Fellows) and Honorary Fellows. The number of Honorary Fellows shall not exceed fifty-six, of whom not more than twenty may be British subjects, and not more than thirty-six subjects of Foreign States.

Fellows only shall be eligible to hold office or to vote at any Meeting of the Society.

## ELECTION OF FELLOWS.

### II.

Each Candidate for admission as a Fellow shall be proposed by at least four Fellows, two of whom must certify from personal knowledge. The Official Certificate shall specify the name, rank, profession, place of residence, and the qualifications of the Candidate. The Certificate shall be delivered to the General Secretary before the 30th of November, and, subject to the approval of the Council, shall be exhibited in the Society's House during the month of January following. All Certificates so exhibited shall be considered by the Council at its first meeting in February, and a list of the Candidates approved by the Council for election shall be issued to the Fellows not later than the 21st of February.

### III.

The election of Fellows shall be by Ballot, and shall take place at the first Ordinary Meeting in March. Only Candidates approved by the Council shall be eligible for election. A Candidate shall be held not elected, unless he is supported by a majority of two-thirds of the Fellows present and voting.

## IV.

On the day of election of Fellows two scrutineers, nominated by the President, shall examine the votes and hand their report to the President, who shall declare the result.

## V.

Each Fellow, after his election, is expected to attend an Ordinary Meeting, and sign the Roll of Fellows, he having first made the payments required by Law VI. He shall be introduced to the President, who shall address him in these words :

*In the name and by the authority of THE ROYAL SOCIETY OF  
EDINBURGH, I admit you a Fellow thereof.*

## PAYMENTS BY FELLOWS.

## VI.

Each Fellow shall, before he is admitted to the privileges of Fellowship, pay an admission fee of three guineas, and a subscription of three guineas for the year of election. He shall continue to pay a subscription of three guineas at the beginning of each session so long as he remains a Fellow.

Each Fellow who was elected subsequent to December 1916 and previous to December 1920 shall also pay a subscription of three guineas at the beginning of each session so long as he remains a Fellow.

Each Fellow who was elected previous to December 1916, and who has not completed his twenty-five annual payments, shall, at the beginning of each session, pay three guineas until his twenty-five annual payments are made. Each Fellow who has completed or shall complete his payments shall be invited to contribute one guinea per annum or to pay a single sum of ten guineas.

A Fellow may compound for the annual subscriptions by a single payment of fifty guineas, or on such other terms as the Council may from time to time fix.

## VII.

A Fellow who, after application made by the Treasurer, fails to pay any contribution due by him, shall be reported to the Council, and, if the Council see fit, shall be declared no longer a Fellow. Notwithstanding such declaration all arrears of contributions shall remain exigible.

## ELECTION OF HONORARY FELLOWS.

## VIII.

Honorary Fellows shall be persons eminently distinguished in Science or Literature. They shall not be liable to contribute to the Society's Funds. Personages of the Blood Royal may be elected Honorary Fellows at any time on the nomination of the Council, and without regard to the limitation of numbers specified in Law I.

## IX.

Honorary Fellows shall be proposed by the Council. The nominations shall be announced from the Chair at the First Ordinary Meeting after their selection. The names shall be printed in the circular for the last Ordinary Meeting of the Session, when the election shall be by Ballot, after the manner prescribed in Laws III and IV for the Election of Fellows.

## EXPULSION OF FELLOWS.

## X.

If, in the opinion of the Council, the conduct of any Fellow is injurious to the character or interests of the Society, the Council may, by registered letter, request him to resign. If he fail to do so within one month of such request, the Council shall call a Special Meeting of the Society to consider the matter. If a majority consisting of not less than two-thirds of the Fellows present and voting decide for expulsion, he shall be expelled by declaration from the Chair, his name shall be erased from the Roll, and he shall forfeit all right or claim in or to the property of the Society.

## XI.

It shall be competent for the Council to remove any person from the Roll of Honorary Fellows if, in their opinion, his remaining on the Roll would be injurious to the character or interests of the Society. Reasonable notice of such proposal shall be given to each member of the Council, and, if possible, to the Honorary Fellow himself. Thereafter the decision on the question shall not be taken until the matter has been discussed at two Meetings of Council, separated by an interval of not less than fourteen days. A majority of two-thirds of the members present and voting shall be required for such removal.

## MEETINGS OF THE SOCIETY.

## XII.

A Statutory Meeting for the election of Council and Office-Bearers, for the presentation of the Annual Reports, and for such other business as may be arranged by the Council, shall be held on the fourth Monday of October. Each Session of the Society shall begin at the date of the Statutory Meeting.

## XIII.

Meetings for reading and discussing communications and for general business, herein termed Ordinary Meetings, shall be held, when convenient, on the first and third Mondays of each month from November to July inclusive, with the exception that in January the meetings shall be held on the second and fourth Mondays.

## XIV.

A Special Meeting of the Society may be called at any time by direction of the Council, or on a requisition to the Council signed by not fewer than six Fellows. The date and hour of such Meeting shall be determined by the Council, who shall give not less than seven days' notice of such Meeting. The notice shall state the purpose for which the Special Meeting is summoned ; no other business shall be transacted.

## PUBLICATION OF PAPERS.

## XV.

The Society shall publish Transactions and Proceedings. The consideration of the acceptance, reading, and publication of papers is vested in the Council, whose decision shall be final. Acceptance for reading shall not necessarily imply acceptance for publication.

## DISTRIBUTION OF PUBLICATIONS.

## XVI.

Fellows who are not in arrear with their Annual Subscriptions and all Honorary Fellows shall be entitled gratis to copies of the Parts of the Transactions and the Proceedings published subsequently to their admission.

Copies of the Parts of the Proceedings shall be distributed by post or otherwise, as soon as may be convenient after publication ; copies of the Transactions or Parts thereof shall be obtainable upon application, either personally or

by an authorised agent, to the Librarian, provided the application is made within five years after the date of publication.

## CONSTITUTION OF COUNCIL.

### XVII.

The Council shall consist of a President, six Vice-Presidents, a Treasurer, a General Secretary, two Secretaries to the Ordinary Meetings (the one representing the Biological group and the other the Physical group of Sciences),\* a Curator of the Library and Museum, and twelve ordinary members of Council.

## ELECTION OF COUNCIL.

### XVIII.

The election of the Council and Office-Bearers for the ensuing Session shall be held at the Statutory Meeting on the fourth Monday of October. The list of the names recommended by the Council shall be issued to the Fellows not less than one week before the Meeting. The election shall be by Ballot, and shall be determined by a majority of the Fellows present and voting. Scrutineers shall be nominated as in Law IV.

### XIX.

The President may hold office for a period not exceeding five consecutive years; the Vice-Presidents, not exceeding three; the Secretaries to the Ordinary Meetings, not exceeding five; the General Secretary, the Treasurer, and the Curator of the Library and Museum, not exceeding ten; and ordinary members of Council, not exceeding three consecutive years; provided that the Treasurer may be re-elected for more than ten successive years in cases where the Council declares to the Society that an emergency exists.

### XX.

In the event of a vacancy arising in the Council or in any of the offices enumerated in Law XVII, the Council shall proceed, as soon as convenient, to elect a Fellow to fill such vacancy for the period up to the next Statutory Meeting.

\* The Biological group includes Anatomy, Anthropology, Botany, Geology, Pathology, Physiology, Zoology; the Physical group includes Astronomy, Chemistry, Mathematics, Metallurgy, Meteorology, Physics.

## POWERS OF THE COUNCIL.

## XXI.

The Council shall have the following powers :—(1) To manage all business concerning the affairs of the Society. (2) To decide what papers shall be accepted for communication to the Society, and what papers shall be printed in whole or in part in the Transactions and Proceedings. (3) To appoint Committees. (4) To appoint employees and determine their remuneration. (5) To award the various prizes vested in the Society, in accordance with the terms of the respective deeds of gift, provided that no member of the existing Council shall be eligible for any such award. (6) To make from time to time Standing Orders for the regulation of the affairs of the Society. (7) To control the investment or expenditure of the Funds of the Society.

At Meetings of the Council the President or Chairman shall have a casting as well as a deliberative vote.

## DUTIES OF PRESIDENT AND VICE-PRESIDENTS.

## XXII.

The President shall take the Chair at Meetings of Council and of the Fellows. It shall be his duty to see that the business is conducted in accordance with the Charter and Laws of the Society. When unable to be present at any Meetings or attend to current business, he shall give notice to the General Secretary, in order that his place may be supplied. In the absence of the President his duties shall be discharged by one of the Vice-Presidents.

## DUTIES OF THE TREASURER.

## XXIII.

The Treasurer shall receive the monies due to the Society and shall make payments authorised by the Council. He shall lay before the Council a list of arrears in accordance with Rule VII. He shall keep accounts of all receipts and payments, and at the Statutory Meeting shall present the accounts for the preceding Session, balanced to the 30th of September, and audited by a professional accountant appointed annually by the Society.

## DUTIES OF THE GENERAL SECRETARY.

## XXIV.

The General Secretary shall be responsible to the Council for the conduct of the Society's correspondence, publications, and all other business except that which relates to finance. He shall keep Minutes of the Statutory and Special

Meetings of the Society and Minutes of the Meetings of Council. He shall superintend, with the aid of the Assistant Secretary, the publication of the Transactions and Proceedings. He shall supervise the employees in the discharge of their duties.

#### DUTIES OF SECRETARIES TO ORDINARY MEETINGS.

##### XXV.

The Secretaries to Ordinary Meetings shall keep Minutes of the Ordinary Meetings. They shall assist the General Secretary, when necessary, in superintending the publication of the Transactions and Proceedings. In his absence, one of them shall perform his duties.

#### DUTIES OF CURATOR OF LIBRARY AND MUSEUM.

##### XXVI.

The Curator of the Library and Museum shall have charge of the Books, Manuscripts, Maps, and other articles belonging to the Society. He shall keep the Card Catalogue up to date. He shall purchase Books sanctioned by the Council.

#### ASSISTANT-SECRETARY AND LIBRARIAN.

##### XXVII.

The Council shall appoint an Assistant-Secretary and Librarian, who shall hold office during the pleasure of the Council. He shall give all his time, during prescribed hours, to the work of the Society, and shall be paid according to the determination of the Council. When necessary he shall act under the Treasurer in receiving subscriptions, giving out receipts, and paying employees.

#### ALTERATION OF LAWS.

##### XXVIII.

Any proposed alteration in the Laws shall be considered by the Council, due notice having been given to each member of Council. Such alteration, if approved by the Council, shall be proposed from the Chair at the next Ordinary Meeting of the Society, and, in accordance with the Charter, shall be considered and voted upon at a Meeting held at least one month after that at which the motion for alteration shall have been proposed.



**Additions to the Library—Presentations, etc.—1929-1930.**

Actes du V<sup>e</sup> Congrès International d'Histoire des Religions à Lund. 27-29  
Août 1929. 8vo. Lund, 1930. (*Presented by the University, Lund.*)

Adachi, Buntaro. Das Arteriensystem der Japaner. Bänden 1 and 2. Fol.  
Kyoto, 1928. (Supplementbände: Acta scholae medicinalis uni-  
versitatis imperialis in Kioto. Vol. IX, 1927.) (*Presented through  
Japanese Embassy, London.*)

Bulletin of the Vanderbilt Marine Museum. Vol. I, No. 1- . 8vo. Hunt-  
ington, L.I., 1929. (*Exchange.*)

Campbell, J. Menzies. Those Teeth of Yours. 8vo. London, 1929. (*Pre-  
sented by Mr J. Menzies Campbell.*)

Carnegie Institution of Washington: Publications:—

No. 254. Davenport, F. G. European Treaties bearing on the History  
of the United States and its Dependencies. Vol. II. 1650-97.  
La. 8vo. Washington, 1929.

No. 371. Bassett, J. S. Correspondence of Andrew Jackson. Vol. IV.  
1829-32. La. 8vo. Washington, 1929.

No. 374. Judicial Cases concerning American Slavery and the Negro.  
Edited by Helen Tunnicliff Catterall. Vol. II. La. 8vo. Wash-  
ington, 1929.

No. 390. Hay, Oliver P. Second Bibliography and Catalogue of the  
Fossil Vertebrata of North America. Vol. I. La. 8vo. Wash-  
ington, 1929.

No. 390. ——— Vol. II. 4to. Washington, 1930.

No. 395. Davenport, C. B., and Morris Steggerda. Race Crossing in  
Jamaica. La. 8vo. Washington, 1929.

No. 398. Plant Competition: an Analysis of Community Functions.  
By F. E. Clements, J. E. Weaver, and H. C. Hanson. 8vo.  
Washington, 1929.

No. 399. Contributions to the Genetics of *Drosophila simulans* and  
*Drosophila melanogaster*. By A. H. Sturtevant, C. B. Bridges,  
T. H. Morgan, L. V. Morgan, and Ju Chi Li. 8vo. Washington,  
1929.

No. 400. A New Method of estimating Steam-Flow based upon a  
New Evaporation Formula. By J. A. Folse. 4to. Washington,  
1929.

No. 402. Seares, F. H., J. C. Kapteyn, and P. J. van Rhijn. Mount  
Wilson Catalogue of Photographic Magnitudes in Selected Areas  
1-139. 4to. Washington, 1930.

No. 405. Flora of the Hermit Shale, Grand Canyon, Arizona. By  
David White. 8vo. Washington, 1929.

——— Reports of the Conferences on Cycles. 4to. Washington,  
1929. (*Exchange.*)

- Chilvers, Hedley A. *The Seven Wonders of Southern Africa*. 8vo. Johannesburg, 1929. (*Presented.*)
- Collected Papers from the Science Laboratories of the University of Melbourne. Vols. III-VI. 1910-28. 8vo. Melbourne, 1929. (*By Exchange.*)
- Comptes Rendus du I Congrès des Mathématiciens des Pays Slaves. Warsaw, 1929. La. 8vo. Warsaw, 1930. (*Presented.*)
- Concise Dictionary of National Biography. Complete to 1921. 8vo. Oxford and London, 1930. (*Purchased.*)
- Conference of Empire Meteorologists, 1929. Agricultural Section. Part 1: Report. Part 2: Papers and Discussions. British Agricultural Meteorological Scheme: Observers' Handbook. 8vo. London, 1929. (*Presented.*)
- Congrès International de Médecine Tropicale et d'Hygiène. Comptes Rendus. Tomes 1 and 2. 4to. Le Caire, 1929. (*Presented.*)
- Contributions from the Biological Laboratory of the Science Society of China. Vol. III, No. 2-. 8vo. Nanking, 1927. (*Exchange.*)
- Coyecque, Ernest. Inventaire de la Collection Anisson sur l'histoire de l'imprimerie et la librairie principalement à Paris, du XIII<sup>e</sup> au XVIII<sup>e</sup> siècle. Tomes 1 and 2. 8vo. Paris, 1899 and 1900. (*Presented by La Bibliothèque Nationale de France.*)
- Davidson, Ellen Scott. *Forerunners of Saint Francis and other Studies*. 8vo. Boston and New York, 1927. (*Presented.*)
- Dawson, Warren R. *The Treasures of Lloyd's*. 4th Edition. 8vo. London, 1930. (*Presented by the Author.*)
- Ergebnisse der Magnetischen Beobachtungen in Potsdam und Seddin, 1914-. 4to. Berlin, 1915. (*Exchange.*)
- Ergebnisse der Meteorologischen Beobachtungen in Potsdam, 1914-. 4to. Berlin, 1915. (*Exchange.*)
- Eugenics Review. Vol. XXI, No. 4-. (January, 1930.) 8vo. London, 1930. (*Presented by Sir E. A. Sharpey-Schafer, F.R.S.*)
- Far-Eastern Association of Tropical Medicine: Transactions of the Seventh Congress, British India, 1927. Vol. III. 4to. Calcutta, 1929. (*Presented.*)
- The Fauna of British India:—  
     Southwell, T. *Cestoda*. Vol. I. 8vo. London, etc., 1930.  
     Baker, E. C. Stuart. *Birds*. Vol. VII. 2nd edition. 8vo. London, 1930. (*Presented by the Government of India.*)  
     ———. *Birds*. Vol. VIII. 2nd edition. 8vo. London, 1930. (*Presented by the Government of India.*)
- Die Fauna Südwest-Australiens. Bd. 5 (and last), Lief. 7-9. 4to. Jena, 1930. (*Presented by Mr William Williamson, F.L.S.*)

- Ferguson, Mungo. A Catalogue of Printed Books in the Hunterian Museum. Fol. Glasgow, 1930. (*Presented by Glasgow University.*)
- Folio Zoologica et Hydrobiologica. Vol. I, No. 1- . (Hydrobiologischen Station der Lettländischen Universität, Riga.) La. 8vo. Riga, 1929. (*Exchange.*)
- Foslie, M. Contributions to a Monograph of the Lithothamnina. Edited by H. Printz. 4to. Trondhjem, 1929. (*Presented by K. Norske Videnskabers Selskab Museet.*)
- Fundamenta Mathematicæ. Tome 1- . 8vo. Warsaw, 1920. (*Exchange.*)
- Goddard, T. Russell. History of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, 1829-1929. 8vo. Newcastle-upon-Tyne, 1929. (*Presented.*)
- Gunther, R. T. Early Science in Oxford. Vol. V. 8vo. Oxford, 1929. (*Purchased.*)
- Helvetica Physica Acta edita a Societate Physica Helvetica. Vol. 1- . 8vo. Basle, 1928- . (*Purchased.*)
- Lebour, Marie V. Planktonic Diatoms of Northern Seas. Ray Society, 1929. 8vo. London, 1930. (*Purchased.*)
- Linguistic Survey of India. Vol. 1, Part 2. Comparative Vocabulary. By Sir George A. Grierson. 4to. Calcutta, 1928. (*Presented by the Government of India.*)
- Lucas, W. J. The Aquatic (Naiad) Stage of the British Dragonflies (Paraneuroptera). 8vo. London, 1930. (*Purchased, Ray Society.*)
- Memoirs: Field Museum of Natural History: Geology. Vol. I, No. 1. 4to. Chicago, 1930. (*Exchange.*)
- Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University, Formosa. La. 8vo. Formosa, Japan, 1930. (*Exchange.*)
- Memoirs of the Geological Survey of the Gold Coast. No. 1- . Fol. Acra and London, 1929. (*Presented.*)
- Memorias de la Real Academia de Ciencias Exactas, Fisicas y Naturales de Madrid. Series de Ciencias Exactas. Tomo 1. 8vo. Madrid, 1930. (*Exchange.*)
- Muir, Sir Thomas, and William H. Metzler. A Treatise on the Theory of Determinants by Sir Thomas Muir. Revised and Enlarged by William H. Metzler. 8vo. New York, 1930. (*Presented by Sir Thomas Muir.*)
- Oeuvres Complètes de Christiaan Huygens. Tome 16. 4to. La Haye, 1929. (*Presented by La Société Hollandaise des Sciences.*)
- Osborn, Henry Fairfield. The Titanotheres of Ancient Wyoming, Dakota, and Nebraska. Vols. I and II. (Monograph 55, U.S. Geological Survey.) 4to. Washington, 1929. (*Exchange.*)

- Pamphlets and Reprints from Professor Raymond Pearl and others. 8vo. Various, 1929. (*Presented by Prof. Pearl.*)
- Peach, B. N., and John Horne. Chapters on the Geology of Scotland. 8vo. Oxford, 1930. (*Presented by the Peach and Horne Trustees.*)
- Pollard, A. F. C. The Kinematical Design of Couplings in Instrument Mechanics. 8vo. London, 1929. (*Presented by Messrs Adam Hilger, Ltd.*)
- Proceedings of the International Mathematical Congress, Toronto, 1924. Vols. I and II. 4to. Toronto, 1928. (*Presented by Toronto University Press.*)
- Publications issued by the Central Scientific Library, Odessa. (*Exchange.*)
- Rendiconti del Circolo Matematico di Palermo. Tomo 54, Fasc. 1-. 8vo. Palermo, 1930. (*Exchange.*)
- Report of the British Association: South Africa, 1929. 8vo. London, 1930. (*Presented by Dr James Currie.*)
- Report of the Director of Veterinary Research, Department of Agriculture, Union of South Africa No. 5-. La. 8vo. Pretoria, 1919. (*Exchange. Laboratories for Veterinary Research, Onderstepoort.*)
- Reprints of Papers by the late John Sturgeon Mackay. (*Presented by Messrs J. & R. Morison & Co., Perth.*)
- Review of Scientific Instruments. New Series. Vol. I, No. 1-. La. 8vo. Menasha, U.S.A., 1930. (*Exchange.*)
- Revista do Museu Paulista, Tome 16-. 4to. São Paulo, 1929. (*Exchange.*)
- Ritchey, G. W. The Development of Astro-Photography and the Great Telescopes of the Future. 4to. Paris, 1929. (*Presented by La Compagnie de Saint Gobain.*)
- Sinensia. Contributions from the Metropolitan Museum of Natural History. National Research Institute. Vol. I, No. 1-. 8vo. Nanking, China, 1929. (*Presented.*)
- Stewart, Balfour, and Tait, P. G. Paradoxical Philosophy: being a sequel to The Unseen Universe. (Proof Sheets.) With pencilled marginal notes by J. Clerk Maxwell. 8vo. London and Cambridge, 1878. (*Presented by Mr J. G. Tait.*)
- Tokyo Imperial University Library: Reconstruction Album, 1923-29. Fol. Tokyo, 1930. (*Presented by the University.*)
- Twyman, F. The Practice of Spectrum Analysis with Hilger Instruments, including a Note on the Various Types of Emission Spectra. 4th edition. 8vo. London, 1929. (*Presented by Messrs Adam Hilger, Ltd.*)
- Wells, John Edwin. Fourth Supplement to a Manual of the Writings in Middle English. 1050-1400. 8vo. New Haven, U.S.A., 1929. (*Exchange.*)

## I. List of Library Exchanges, etc.

(As at December 1930).

I. TRANSACTIONS AND PROCEEDINGS OF LEARNED SOCIETIES, ACADEMIES, ETC., RECEIVED BY EXCHANGE OF PUBLICATIONS, AND LIST OF PUBLIC INSTITUTIONS ENTITLED TO RECEIVE COPIES OF THE TRANSACTIONS AND PROCEEDINGS OF THE ROYAL SOCIETY OF EDINBURGH. (For convenience certain Presentations are included in this List.)

II. LIST OF PERIODICALS ADDED BY PURCHASE, ETC. (see pp. 443-447).

T.P. prefixed to a name indicates that the Institution is entitled to receive *Transactions* and *Proceedings*. P. indicates *Proceedings*.

\* signifies that only the Papers bearing on a particular class of subject are supplied.

### AFRICA.

ACCRA (Gold Coast)—Report, Geological Survey Memoir. (*Presented.*)

ZOMBA—*Scientific Department*. Meteorological Observations. (*Presented by H.M. Acting Commissioner and Consul-General.*)

AMERICA (NORTH). (See CANADA, UNITED STATES, AND MEXICO.)

### AMERICA (SOUTH).

BUENOS AIRES (ARGENTINE REPUBLIC)—

T.P. *Museo Nacional*. Anales.

*Oficina Meteorologica Argentina*. Anales.—Boletin Mensual. (*Presented.*)

P. *Seminario Matemático Argentino*. Boletin.

P. *Sociedad Argentina de Ciencias Naturales*. Physis.

P. *Sociedad Científica Argentina*. Anales.

CORDOBA—

T.P. *Academia Nacional de Ciencias de la Republica Argentina*. Boletin.—Actas.—Miscelanea.

T.P. *National Observatory*. Resultados.

LA PLATA (ARGENTINE REPUBLIC)—

T.P. *Museo de la Plata*. Revista.—Anales, etc.

P. *University*. Publications.

LIMA (PERU)—*Cuerpo de Ingenieros de Minas del Peru*. Boletin. (*Presented.*)

P. MONTEVIDEO (URUGUAY)—*Museo Nacional*. Anales.

T.P. PARÀ (BRAZIL)—*Museu Goeldi*. Boletim.

P. QUITO (ECUADOR)—*Observatorio Astronómico y Meteorológico*. Boletin, etc.

RIO DE JANEIRO (BRAZIL)—

*Academia Brasileira de Sciencias*. Annaes. (*Presented.*)

*Escola Superiore de Agricultura e Medicina Veterinaria*. Archivos. (*Presented.*)

P. *Museu Nacional*. Revista (Archivos). Boletim, etc.

T.P. *Observatorio*. Anuario.—Boletim Mensal.

SANTIAGO (CHILI)—

*Instituto Meteorologico y Geofisico de Chili.* Publicacion.—Anuario.  
(Presented.)

T.P. *Société Scientifique du Chili.* Actes.

T.P. SAN PAULA—*Museu Paulista.* Revista.

P. SAN SALVADOR—*Observatorio Meteorológico.* Anales.

AUSTRALIA.

*Australasian Association for the Advancement of Science.*—Reports. (Presented.)

ADELAIDE—

*Observatory.* Annual Report. (Presented.)

P. *Royal Geographical Society of Australasia (South Australian Branch).* Proceedings.

T.P. *Royal Society of South Australia.* Transactions and Proceedings.—Memoirs.

P. *University Library.* Australian Journal of Experimental Biology and Medical Science.—Publications. Animal Products Research Association.—Annual Report.

BRISBANE—

P. *Government Meteorological Office.*

T.P. *Queensland Museum.* Memoirs.

P. *Royal Geographical Society (Queensland Branch).* Queensland Geographical Journal.—Transactions.

P. *Royal Society of Queensland.* Proceedings.

T.P. *University of Queensland.*

P. GEELONG (VICTORIA)—*Gordon Technical College.*

T.P. HOBART—*Royal Society of Tasmania.* Papers and Proceedings.

MELBOURNE—

*Commonwealth of Australia.* Official Year-book.—Service Publication.  
(Presented.)

*National Museum.* Memoirs. (Presented.)

P. *Royal Society of Victoria.* Proceedings.—Transactions.

T.P. *University Library.*

PERTH, W.A.—

P. *Geological Survey.* Annual Progress Reports.—Bulletins.

*Government Statistician's Office.* Monthly Statistical Abstract, etc. (Presented.)

T.P. *Royal Society of Western Australia.* Journal and Proceedings.

SYDNEY—

*Australasian Antarctic Expedition, 1911-14.* Scientific Reports. (Presented.)

T.P. *Australian Institute of Tropical Medicine.* Publications.

T.P. *Australian Museum.* Records.—Reports.—Memoirs.—Catalogues.

*Australian National Research Council.* Australian Science Abstracts.  
(Presented.)

T.P. *Department of Mines and Agriculture (Geological Survey), N.S.W.* Records.—Annual Reports.—Memoirs.—Mineral Resources.—Bulletin.

## SYDNEY—continued—

- T.P. *Linnean Society of New South Wales. Proceedings.*  
*N.S.W. Government. Fisheries Report. (Presented.)*
- T.P. *Royal Society of New South Wales. Journal and Proceedings.*
- T.P. *University Library. Calendar.—Sydney University Reprints.—Journal of the Cancer Research Committee.*

## AUSTRIA.

## GRAZ—

- T.P. *Naturwissenschaftlicher Verein für Steiermark. Mittheilungen.*

## VIENNA—

- T.P. *Akademie der Wissenschaften. Denkschriften.—Sitzungsberichte.—Almanach.—Mittheilungen der Erdbeben Commission.*  
*Central-Anstalt für Meteorologie und Geodynamik. Jahrbücher.—Allgemeiner Bericht und Chronik. (Presented.)*
- T.P. *Geologische Bundesanstalt. Abhandlungen.—Jahrbücher.—Verhandlungen.*
- P. *Math. Institut der Universität. Monatshefte.*
- T.P. *Naturhistorisches Museum. Annalen. Denkschriften.*
- T.P. *Oesterreichische Gesellschaft für Meteorologie. Meteorologische Zeitschrift.*
- T.P. *Universität. Bibliothek.*
- T.P. *Zoologisch-Botanische Gesellschaft. Verhandlungen.—Abhandlungen.*  
*Zoologisches Institut der Universität und der Zoologischen Station in Triest. Arbeiten. (Purchased.)*

## BELGIUM.

## BRUSSELS—

- T.P. *Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique. Mémoires.—Bulletins.—Annuaire.—Biographie Nationale.*  
*L'Institut Royale Météorologique. Annuaire. (Presented.)*
- T.P. *Musée du Congo. Annales.—Botanique. Zoologie. Ethnographie et Anthropologie. Linguistique, etc.*
- T.P. *Musée Royal d'Histoire Naturelle. Mémoires.*
- T.P. *L'Observatoire Royal de Belgique, Uccle. Annuaire.—Annales.—Physique du Globe.—Bulletin Sismique.*
- P. *Société Belge d'Astronomie. Ciel et Terre.*
- T.P. *Société Scientifique. Annales.*
- T.P. *GHENT—University Library.*
- T.P. *LOUVAIN—University Library.*

## BULGARIA.

- P. *SOFIA—Institut Météorologique de Bulgarie. Bulletin Mensuel.—Bulletins Annuaire.—Tremblements de Terre.*

## CANADA.

- P. *HALIFAX (NOVA SCOTIA)—Nova Scotian Institute of Science. Proceedings and Transactions.*
- T.P. *KINGSTON—Queen's University.*

MONTREAL—

- P. *Engineering Institute of Canada*. Engineering Journal.—Transactions.  
 T.P. *McGill University*. Publications.  
 P. *Natural History Society* (now *Blacketer Library of Zoology, McGill University Library*). Proceedings.—Canadian Record of Science.

OTTAWA—

- Canadian Arctic Expedition* (1913–18). Report. (*Presented.*)  
 T.P. *Geological Survey of Canada*. Annual Reports.—Maps, Memoirs, and other Publications.  
 P. *Literary and Scientific Society*. Transactions.  
*National Research Council of Canada*. Canadian Journal of Research. (*Presented.*)  
 T.P. *Royal Society of Canada*. Proceedings and Transactions.  
 T.P. QUEBEC—*Literary and Historical Society*. Transactions.

TORONTO—

- Biological Board of Canada*. Bulletin.—Studies.—Contributions. (*Presented.*)  
 P. *Royal Astronomical Society of Canada*. Journal.—Observer's Handbook.  
 T.P. *Royal Canadian Institute*. Transactions.  
 T.P. *University*. University Studies, etc.  
 VICTORIA—*Dominion Astrophysical Observatory*. Publications. (*Presented.*)

CAPE COLONY. (See UNION OF SOUTH AFRICA.)

CEYLON.

- T.P. COLOMBO—*Museum*. Spolia Zeylanica. Memoirs.—Annual Report.—Ceylon Journal of Science.  
 \*T.P. PERADENIYA—*Department of Agriculture*. Ceylon Journal of Science.

CHINA.

HONG KONG—

- P. *Royal Observatory*. Monthly Meteorological Bulletin.—Monthly Seismological Bulletin.—Report.  
 \*T. *Kwangtunk and Kwangsi Geological Survey*.  
 P. NANKING—*Science Society of China*. Contributions.  
 T.P. PEKING—*Geological Survey of China*. Bulletins.—Memoirs.  
*Palæontologica Sinica*.

CZECHOSLOVAKIA.

BRNO—

- L'École des Hautes Études Vétérinaires*. Pubns. Biologiques. (*Presented.*)  
 P. *Masaryk University*. Publications.  
*Societas Scientiarum Naturalium Moravica*. Acta. (*Presented.*)

PRAGUE—

- T.P. *Böhmische Akademie der Wissenschaften*. Almanach.—Vestník (Proceedings).—Rozpravy (Transactions).—Historický Archiv.—Bulletin International, and other publications of the Academy.



## PRAGUE—continued—

- Czechoslovak Academy of Agriculture.* Vestnik.—Sbornik. (Presented.)  
 P. *Deutscher Nat.-Med. Verein für Bohmen "Lotos."*—Lotos.  
 T.P. *Kralovská česká společnost nauk.* Vestnik, etc.  
 T.P. *Sternwarte.* Magnetische und Meteorologische Beobachtungen. Astro-  
 nomische Beobachtungen, etc.

## DENMARK.

CARLSBERG—*Compte Rendu des Travaux au Laboratoire de Carlsberg.*  
 (Presented.)

## COPENHAGEN—

- T.P. *Académie Royale de Copenhague.* Mémoires: Classe des Sciences.—  
 Oversigt. Meddelelser.  
 T.P. *Conseil Permanent International pour l'Exploration de la Mer.* Publica-  
 tions de circonstance.—Rapports et Procès-Verbaux de Réunions.—  
 Bulletin des Résultats acquis pendant les croisières périodiques (1902-05).  
 —Bulletin Statistique.—Bulletin Hydrographique.—Journal du Conseil,  
 etc.  
 P. *Danish Biological Station.* Report.  
 P. *Dansk Naturhistorisk Forening.* Videnskabelige Meddelelser.  
*Kommissionen for Havundersogelser.* Meddelelser.—Série Fiskeri.—Série  
 Plankton.—Série Hydrografi.—Skrifter. (Presented.)  
*University (Zoological Museum).* Reports of the Danish Ingolf-Expedi-  
 tion. (Presented.)

## EGYPT.

## CAIRO—

- Cotton Research Board.* Report. (Presented.)  
*Ministry of Finance (Survey Dept.).* Palaeontological Series.—Petroleum  
 Research Bulletin. *Archæological Survey of Nubia.*—Papers. (Pre-  
 sented.)  
 T.P. *School of Medicine.* Records.

## ENGLAND AND WALES.

T.P. ABERYSTWYTH—*National Library of Wales.*

## BIRMINGHAM—

- Birmingham and Midland Institute Scientific Society.* Record and Pro-  
 ceedings. (Presented.)  
 P. *Nat. Hist. and Philosophical Society.* Proceedings.—Annual Report.  
*University.* Calendar. (Presented.)

BRISTOL—*Museum and Art Gallery.* Report. (Presented.)

## CAMBRIDGE—

- T.P. *Philosophical Society.* Transactions.—Proceedings.—Biological Reviews.  
 T.P. *University Library.—Observatory.* Reports.—Observations.—Annals.

CARDIFF—

- P. *National Museum of Wales*. Annual Report.—Guides, etc.  
T.P. *University College of South Wales*.

CULLERCOATS—*Dove Marine Laboratory*. Reports. (*Presented*.)

- P. **ESSEX**—*Essex Field Club*. The Essex Naturalist.  
T.P. **GREENWICH**—*Royal Observatory*. Observations. — Photo-heliographic Results and other Publications.  
T.P. **HARPENDEN (HERTS.)**—*Rothamstead Exp. Station*. (*Lawes Agricultural Trust*.) Annual Report.

LEEDS—

- T.P. *Philosophical and Literary Society*. Reports.—Proceedings.  
P. *Yorkshire Geological and Polytechnic Society*. Proceedings.

LIVERPOOL—

- P. *Biological Society*. Proceedings and Transactions.  
P. *Geological Society*. Proceedings.  
T.P. *University Library*.

LONDON—

- Adam Hilger, Ltd.* Bulletin of Spectrum Analysis.—Bulletin of Development. (*Presented*.)  
P. *Admiralty*. Nautical Almanac and Astronomical Ephemeris.—Health of the Navy (Annual Report).  
P. *Agent-General for West Australia*.  
T.P. *Athenæum Club*.  
*British Antarctic Expedition (Terra Nova), 1910-13*. Reports. (*Presented*.)  
*British Association for the Advancement of Science*. Reports. (*Purchased*.)  
P. *British Astronomical Association*. Journal.—Observer's Handbook.—Memoirs.  
T.P. *British Museum (Copyright Office)*.  
T.P. *British Museum. Natural History Department*. Catalogues, Monographs, Lists, etc. *British Antarctic Expedition (Terra Nova), 1910-13*.  
T.P. *Chemical Society*. Journal.—Abstract of Proceedings.  
*Colonial Office*. Discovery Reports. (*Presented*.)  
P. *Department of Scientific and Industrial Research*. Reports.—Miscellaneous Publications.  
*Entomological Society*. Transactions, 1906-25. (*Purchased*.)  
P. *Faraday Society*. Transactions.  
T.P. *Geological Society*. Quarterly Journal.—Geological Literature.—Abstract of Proceedings.  
T.P. *Geological Survey of the United Kingdom*. Summary of Progress.—Memoirs, etc.  
P. *Geologists' Association*. Proceedings.  
T.P. *Hydrographic Office*.  
T.P. *Imperial Institute*. Bulletin.—Annual Report.  
T.P. *Institution of Civil Engineers*. Minutes of Proceedings, etc.  
T.P. *Institution of Electrical Engineers*. Journal.

## LONDON—continued—

- P.     *Institution of Mechanical Engineers.* Proceedings.  
*International Catalogue of Scientific Literature.*
- T.P.   *Linnean Society.* Journal.—Transactions.—Proceedings.
- P.     *Mathematical Society.* Proceedings.—Journal.
- \*(T.)P. *Meteorological Office.* Report of the Meteorological Committee.—Reports of the International Meteorological Committee.—Hourly Readings.—Daily and Weekly Weather Reports.—Monthly and Quarterly Summaries.—Meteorological Observations at Stations of First and Second Order.—Geophysical Journal.—Geophysical Memoirs, and other Publications.
- Mineralogical Society of Great Britain and Ireland.* Mineralogical Magazine and Journal. (*Presented.*)
- T.P.   *Ministry of Agriculture and Fisheries.* Publications.—Bulletin.—Bibliography of Literature, etc.
- P.     *Optical Society.* Transactions.
- Palæontographical Society.* Publications. (*Purchased.*)
- P.     *Pharmaceutical Society.* Journal.—Calendar.
- P.     *Physical Society.* Proceedings.
- Ray Society.* Publications. (*Purchased.*)
- P.     *Royal Aeronautical Society.* Aeronautical Journal.—Aeronautical Classics.—Reports of the Bird Construction Committee.
- T.P.   *Royal Anthropological Institute.* Journal.
- T.P.   *Royal Astronomical Society.* Monthly Notices.—Memoirs.—Geophysical Supplement.
- T.P.   *Royal College of Surgeons.*
- T.P.   *Royal Geographical Society.* Geographical Journal.
- T.P.   *Royal Horticultural Society.* Journal.
- T.P.   *Royal Institution.* Proceedings.
- P.     *Royal Meteorological Society.* Quarterly Journal.—Memoirs, etc.
- T.P.   *Royal Microscopical Society.* Journal.
- P.     *Royal Photographic Society.* Photographic Journal. Photographic Abstracts.
- T.P.   *Royal Society.* Philosophical Transactions.—Proceedings.—Year-book.
- T.P.   *Royal Society of Arts.* Journal.
- T.P.   *Royal Society of Literature.* Transactions; Essays by Divers Hands.
- T.P.   *Royal Society of Medicine.* Proceedings.—Official Bulletin.
- T.P.   *Royal Statistical Society.* Journal.
- Safety in Mines Research Board.* Papers.—Annual Report. (*Presented.*)
- T.P.   *Science Museum (Science Library).*
- Society of Chemical Industry.* Journal. (*Presented.*) (*Stopped 1920.*)
- T.P.   *United Service Institution.*
- T.P.   *University College.* Calendar.
- T.P.   *University.*
- \* P.   *Wellcome Chemical Research Laboratories.* Papers.
- T.P.   *Zoological Society.* Transactions.—Proceedings.
- \* T.P.   The Editor of *Nature*—*Nature*.
- T.P.   The Editor of *Science Abstracts*—*Science Abstracts*.
- \* T.P.   The Editor of *Science Progress*.

MANCHESTER—

- Godlee Observatory. Report. (Presented.)*  
*Lancashire and Cheshire Fauna Committee. Annual Report. (Presented.)*  
 T.P. *Literary and Philosophical Society. Memoirs and Proceedings.*  
*Metropolitan Vicker's Gazette. (Presented.)*  
 P. *Microscopical Society. Transactions and Annual Report.*  
 T.P. *University. Publications.*

NEWCASTLE-ON-TYNE—

- T. *Armstrong College.—University.*  
 P. *Literary and Philosophical Society.*  
 P. *Natural History Society of Northumberland, Durham, etc. Transactions.*  
 T.P. *North of England Institute of Mining and Mechanical Engineers. Transactions.—Annual Reports.*  
*University of Durham Philosophical Society (Armstrong College). (See above). Proceedings.*  
 P. NORWICH—*Norfolk and Norwich Naturalists' Society. Transactions.*

OXFORD—

- P. *Ashmolean Society. Proceedings and Report.*  
 T.P. *Bodleian Library.*  
 P. *Radcliffe Observatory. Results of Meteorological Observations.*  
 P. PENZANCE—*Royal Geological Society of Cornwall. Transactions.*  
 T.P. PLYMOUTH—*Marine Biological Association. Journal.*  
 T.P. RICHMOND (SURREY)—*Kew Observatory.*  
 P. SCARBOROUGH—*Philosophical Society.*  
 T.P. SHEFFIELD—*University.*  
 SOUTHPORT—*Meteorological Observatory. Annual Report and Results of Observations. Joseph Baxendell, Meteorologist. (Presented.)*  
 T.P. TEDDINGTON (MIDDLESEX)—*National Physical Laboratory. Collected Researches.—Annual Reports.*  
 P. TRURO—*Royal Institution of Cornwall. Journal.*  
 T.P. YORK—*Yorkshire Philosophical Society. Reports.*

ESTHONIA.

- T.P. DORPAT (JURJEW)—*University. Acta.—Sitzungsberichte der Naturforscher Gesellschaft bei der Universität.—Schriften.*

FINLAND.

- P. ABÓ—*Abó Academy. Acta.*

HELSINGFORS—

- Academia Scientiarum Fennica. Annales.—Sitzungsberichte.—Documenta Historica.—Veröffentlichungen, etc. (Presented.)*  
*Geodätisches Institut. Publications. (Presented.)*  
*Institut für Meeresforschung.—Merentutkimuslaitoksen Julkaisu. (Presented.)*  
 T.P. *Societas pro Fauna et Flora Fennica. Acta Zoologica Fennica.—Acta.—Meddelanden.—Flora Fennica, etc.*  
 T.P. *Societas Scientiarum Fennica (Société des Sciences de Finlande). Acta.—Öfversigt.—Bidrag.—Commentationes.*

## HELSINGFORS—continued—

- P. *Société de Géographie de Finlande*. Fennia.—Meddelanden.—Acta Geographica.  
*Suomen Metsätietullinen Seura*. Acta. (Presented.)

## FRANCE.

BESANCON—*Université Observatoire National*. Bulletin Chronométrique et Bulletin Météorologique. (Presented.)

## BORDEAUX—

- L'Observatoire*. Catalogue Photographique du Ciel. (Presented.)  
 P. *Société de Géographie Commerciale*. Revue.  
 T.P. *Société des Sciences Physiques et Naturelles*. Mémoires.—Procès-Verbaux des Séances.  
 P. CHERBOURG—*Société Nationale des Sciences Naturelles et Mathématiques*. Mémoires.  
 P. CONCARNEAU—*Collège de France (Laboratoire de Zoologie et de Physiologie Maritimes)*. Travaux Scientifiques.  
 P. DIJON—*Académie des Sciences*. Mémoires.

## LILLE—

- T.P. *Société des Sciences de l'Agriculture et des Arts*. Bulletin des Séances.—Mémoires.  
 T.P. *Société Géologique du Nord*. Annales.—Mémoires.  
 P. *Université de France*. Travaux et Mémoires.

## LYONS—

- T.P. *Académie des Sciences, Belles Lettres et Arts*. Mémoires.  
 T.P. *Société d'Agriculture, Sciences et Industrie*. Annales.  
 P. *Société Botanique*. Annales.  
     *Société Linnéenne*. Annales.  
 T.P. *Université*. Annales.

## MARSEILLES—

- T.P. *Faculté des Sciences*. Annales.  
 P. *Société Scientifique Industrielle*. Bulletin.  
 T.P. MONTPELLIER—*Académie des Sciences et Lettres*. Mémoires.—Bulletin.  
 T.P. NANTES—*Société des Sciences Naturelles de l'Ouest de la France*. Bulletin.  
 T.P. NICE—*L'Observatoire*. Annales.

## PARIS.—

- T.P. *Académie d'Agriculture de France*. Comptes Rendus.  
 T.P. *Académie des Inscriptions et Belles-Lettres*. Comptes Rendus.  
 T.P. *Académie des Sciences*. Mémoires.—Comptes Rendus.—Annuaire.  
 T.P. *Association Française pour l'Avancement des Sciences*. Comptes Rendus.—Bulletin.  
 T.P. *Bureau International des Poids et Mesures*.—Procès-Verbaux des Séances.—Travaux et Mémoires, etc.  
 T.P. *Bureau des Longitudes*. Annuaire.—Connaissance des Temps.  
 T.P. *Cabinet du Département des Sciences Mathématiques, Faculté des Sciences, Université de Paris*.  
 T.P. *École des Mines*. Annales des Mines.

PARIS—continued—

- P. *École des Ponts et Chaussées.*
- P. *École Libre des Sciences Politiques.*
- T.P. *École Normale Supérieure. Annales.*
- T.P. *École Polytechnique. Journal.*
- T.P. *Institut Océanographique. Annales.*
- P. *Journal de Physique et le Radium.*
- T.P. *Ministère de l'Instruction Publique. Bibliographie Scientifique.*
- T.P. *Ministère de l'Instruction Publique. Section des Sciences (Comité des Travaux Historiques). Comptes Rendus.—Congrès des Sociétés Savantes de Paris.*
- T.P. *Ministère de la Marine. (Service Hydrographique.) Annales Hydrographiques. (Stopped.)*
- T.P. *Muséum d'Histoire Naturelle. Nouvelles Archives.—Bulletin.*
- T.P. *L'Observatoire National. Rapport Annuel.—Annales.—Mémoires.—Carte Photographique du Ciel.—Catalogue Photographique du Ciel.*
- T.P. *L'Observatoire d'Astronomie Physique de Meudon. Annales. (Presented.)*
- P. *Revue Générale des Sciences Pures et Appliquées.*
- T.P. *Section de Géodésie de l'Union Géodésique, etc. Bulletin Géodésique. (Presented.)*
- P. *Société d'Anthropologie. Bulletin et Mémoires.*
- T.P. *Société Nationale des Antiquaires. Mémoires.—Bulletin.*
- T.P. *Société de Biologie. Comptes Rendus.*
- P. *Société de Chimie Industrielle. "Chimie et Industrie."*
- T.P. *Société d'Encouragement pour l'Industrie Nationale. Bulletin.*
- P. *Société Française de Physique. Annuaire.—Procès-Verbaux.*
- T.P. *Société de Géographie. La Géographie.*
- T.P. *Société Géologique de France. Bulletins.—Mémoires (Paléontologie), etc.*
- T.P. *Société Mathématique. Bulletin.—Comptes Rendus.*
- P. *Société Philomathique. Bulletin.*
- T.P. *Société Zoologique. Bulletin.—Mémoires.*
- T.P. RENNES—*Société Scientifique de Bretagne. Bulletin.*
- T.P. STRASBOURG—*University.*
- T.OULOUSE—
- P. *Académie des Sciences. Mémoires.*
- T.P. *Université.—Faculté des Sciences.—Annales. L'Observatoire.—Annales.*

GERMANY.

BERLIN—

- T.P. *Deutsche Geologische Gesellschaft. Zeitschrift.—Monatsberichte.*
- T.P. *Deutsche Wissenschaft u. Technik. Forschungen u. Fortschritte. (Presented.)*
- P. *Gesellschaft Naturforschender Freunde. Sitzungsberichte.—Archiv für Biontologie.*
- \*T.P. *Die Naturwissenschaften.*
- T.P. *Physikalische Gesellschaft. Verhandlungen.—Zeit. für Physik. (By Purchase.)*
- P. (Potsdam) *Preussisches Meteorologisches Institut. Ergebnisse.*

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BERLIN—continued—

- T.P. (Potsdam) *Astrophysikalisches Observatorium*. Publikationen.  
 T.P. *Preussische Akademie der Wissenschaften*. Abhandlungen.—Sitzungs-  
 berichte.  
 P. *Technische Hochschule*.  
 T.P. *Zoologisches Museum*. Mitteilungen.—Berichte.

BONN—

- T.P. *Naturhistorischer Verein der Preussischen Rheinlande und Westfalens*. Ver-  
 handlungen.—Sitzungsberichte.  
*Niederrheinische Gesellschaft für Natur-und Heilkunde*. Sitzungsberichte.  
 (Presented.)  
 T.P. BREMEN—*Naturwissenschaftlicher Verein*. Abhandlungen.  
 BRUNSWICK—*Verein für Naturwissenschaft*. Jahresberichte. (In abeyance.)  
 P. CARLSRUHE—*Technische Hochschule*.  
 P. CASSEL—*Verein für Naturkunde*. Abhand. u. Berichte.  
 T.P. CHARLOTTENBURG—*Physikalisch-Technische Reichsanstalt*. Abhandlungen.  
 —Bericht.

DANTZIG—

- T.P. *Naturforschende Gesellschaft*. Schriften.—Abhandlungen.  
*Westpreussischer Botanisch-Zoologischer Verein*. Berichte. (Presented.)

ERLANGEN—

- P. *Physikalisch-Medicinische Societät*. Sitzungsberichte.  
*University*. Inaugural Dissertations. (In abeyance.)  
 T.P. FRANKFURT-AM-MAIN—*Senckenbergische Naturforschende Gesellschaft*. Ab-  
 handlungen.—Berichte.  
 P. FRANKFURT-AM-ODER—*Naturwissenschaftlicher Verein*. Helios.  
 P. FREIBURG-I-BR—*Naturforschende Gesellschaft*. Berichte.

GIESSEN—

- P. *Oberhessische Gesellschaft für Natur-und Heilkunde*. Berichte.  
 T.P. *University*. Inaugural Dissertations.  
 T.P. GÖTTINGEN—*Gesellschaft der Wissenschaften*. Abhandlungen.—Nachrichten.  
 —Geschäftliche Mittheilungen.—Gelehrte Anzeigen.

HALLE—

- P. *Deutsche Mathematiker-Vereinigung*. Jahresbericht.  
 T.P. *Kaiserl. Leopold. Deutsche Akademie der Naturforscher*. Nova Acta (Ver-  
 handlungen).—Leopoldina (Berichte).  
 T.P. *Naturforschende Gesellschaft u. Naturwissenschaftlicher Verein für Sachsen*  
*u. Thüringen*. (These Societies have same Library.) Abhandlungen.  
 P. *Verein für Erdkunde*. Mittheilungen.—Zeitschrift.

HAMBURG—

- T.P. *Deutsche Seewarte*. Annalen der Hydrographie, etc.  
 P. *Mathematische Seminar*. Abhandlungen.  
 T.P. *Naturwissenschaftlicher Verein*. Abhandlungen aus dem Gebiete der  
 Naturwissenschaften.—Verhandlungen.  
 T.P. *Zoologische Staatinstitut u. Zoologische Museum*. Jahrbuch.—Beihefte.—  
 Mitteilungen.  
 T.P. HANOVER—*Naturhistorische Gesellschaft*. Jahresbericht.  
 T.P. HEIDELBERG—*Akademie der Wissenschaften*. Sitzungsberichte.—Abhandl.  
 Jahresheft.

- T.P. HELGOLAND—*Biologisches Anstalt*. Wissenschaftliche Meeresuntersuchungen (Abtheilung Helgoland).
- T.P. JENA—*Medicinisch-Naturwissenschaftliche Gesellschaft*. *Jenaische Zeitschrift für Naturwissenschaft*.—Denkschriften.
- KIEL—
- P. *Naturwissenschaftlicher Verein für Schleswig-Holstein*. Schriften.
- T.P. *Universität*. Dissertations.
- KONIGSBERG—*University*. (In abeyance.)
- LEIPZIG—
- Deutsche Mathematiker-Vereinigung*. (See HALLE.)
- Fürstlich Jablonowskische Gesellschaft*. Preisschriften. (Presented.)
- Naturforschende Gesellschaft*. Sitzungsberichte. (In abeyance.)
- T.P. *Sächsische Akademie der Wissenschaften*. Berichte.—Abhandlungen.—Sitzungsberichte.
- P. LÜBECK—*Geographische Gesellschaft und Naturhistorisches Museum*. Mittheilungen.
- MAGDEBURG—*Naturwissenschaftlicher Verein*. Abhandlungen u. Berichte. (In abeyance.)
- T.P. MUNICH—*Bayerische Akademie der Wissenschaften*. Abhandlungen. Sitzungsberichte.—Jahrbuch.
- K. *Sternwarte*. *Neue Annalen*. (Presented.)
- P. OFFENBACH—*Verein für Naturkunde*. Berichte.
- P. OSNABRÜCK—*Naturwissenschaftlicher Verein*. Jahresbericht.
- POTS DAM. (See BERLIN.)
- P. { ROSTOCK-I-M.—*Naturforschende Gesellschaft*. Sitzungsberichte und Abhandlungen.  
University.
- T.P. STUTTGART—*Verein für vaterländische Naturkunde in Württemberg*. Jahreshefte.
- TÜBINGEN—
- University*. Inaugural Dissertations. (In abeyance.)
- Naturwissenschaftliche Abhandlungen*. (Presented.)

## GREECE.

### ATHENS—

- T.P. *Académie d'Athens*. *Practica*.
- T.P. *Observatoire National*. *Annales*.
- T.P. *University Library*.

## HAWAIIAN ISLANDS.

- P. HONOLULU—*Bernice Pauahi Bishop Museum of Polynesian Ethnology*. Occasional Papers.—Memoirs.—Bulletin.

## HOLLAND.

### AMSTERDAM—

- T.P. *Kon. Akademie van Wetenschappen*. *Verhandelingen*.—*Verslagen en Mededeelingen*; *Letterkunde*.—*Verslagen van de gewone Vergaderingen der Afdeeling Natuurkunde*.—*Jaarboek*.—*Proceedings of the Section of Sciences*.



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AMSTERDAM—continued—

- T.P. *Koninklijk Zoologisch Genootschap "Natura Artis Magistra."* Bijdragen tot de Dierkunde.
- P. *Nederlandsche Botanische Vereeniging.* Nederlandsch Kruidkundig Archief.—Verslagen en Mededeelingen.—Recueil des Travaux Botaniques Néerlandaises.
- P. *Wiskundig Genootschap.* Nieuw Archief voor Wiskunde.—Wiskundige Opgaven.—Revue Semestrielle des Publications Mathématiques.
- \*T.P. DE BILT—*Koninklijk Nederlandsch Meteorologisch Instituut.* Annuaire, etc.
- T.P. DELFT—*École Polytechnique.* Dissertations.
- T.P. GRONINGEN—*University.* Jaarboek.

HAARLEM—

- T.P. *Hollandsche Maatschappij der Wetenschappen.* Naturkundige Verhandelingen.—Archives Néerlandaises des Sciences Exactes et Naturelles.
- T.P. *Musée Teyler.* Archives.  
*Teyler's Godgeleerd Genootschap.* Verhandelingen. (Presented.)
- LA HAYE—*Ministère de l'Instruction des Beaux-Arts et des Sciences.* Division des Beaux-Arts et des Sciences. Flora Batava. (Presented.)
- T.P. HELDER—*Nederlandsche Dierkundige Vereeniging.* Tijdschrift.

LEYDEN—

- T.P. *The University.* Sternwarte.—Annalen.
- P. *The University.* Naturkundige Laboratorium. Contributions.
- T.P. ROTTERDAM—*Bataafsch Genootschap der Proefondervindelijke Wijsbegeerte.* Nieuwe Verhandelingen.—Verslag.

UTRECHT—

- L'Observatoire.* Recherches Astronomiques. (Presented.)
- P. *Provinciaal Utrechtsch Genootschap van Kunsten en Wetenschappen.* Verslag van de Algemeene Vergaderingen. Aanteekeningen van de Sectie Vergaderingen.  
*Secrétariat du Comité Météorologique International.* Rapport. (Presented.)

HUNGARY.

BUDA-PESTH—

- T.P. *Kir-Magy. Természettudományi Társulat (Royal Hungarian Society of Nat. Sciences).* Botanikai Közlemények.—Allattani Közlemények.
- P. *Magyar Királyi Ornithologicii Központ (Royal Hungarian Central-Bureau for Ornithology).* Aquila.
- T.P. *Magyar Tudományos Akadémia (Hungarian Academy).* Mathemat. és természettud. közlemények (Communications Math. and Nat. Sciences).—Mathemat. és természettud. Értesítő (Bulletin, Math. and Nat. Sciences).—Almanach.—Mathematische und Naturwissenschaftliche Berichte aus Ungarn.—And other publications of the Hungarian Academy, or works published under its auspices.
- T.P. TIBANY (LAKE BALATON)—Hungarian Research Station. Archivum Balatonicum.

ICELAND.

REYKJAVIK—

- P. *Íslenzka Fornleifafélag.*  
*Societas Scientiarum Islandica.* (Presented.)

INDIA.

BANGALORE—Meteorological Results of Observations taken at Bangalore, Mysore, Hassan, and Chitaldroog Observatories; Report of Rainfall Registration in Mysore. Mysore Meteorological Memoirs. (Presented by the Mysore Government.)

- P. *University of Mysore.* Journal.  
 P. *BENARES—Mathematical Society.* Proceedings.

BOMBAY—

- Archæological Survey of Western India.* Progress Reports. (Presented.)  
 T.P. *Elphinstone College.*  
 P. *Government Observatory.* Magnetic and Meteorological Observations.  
*Natural History Society.* Journal. (Purchase.)  
 T.P. *Royal Asiatic Society (Bombay Branch).* Journal.

BURMA—Reports on Archæological Work in Burma. (Presented by the Government.)

CALCUTTA—

- Archæological Survey of India.* Epigraphia Indica.—Annual Reports, etc. (Presented by the Indian Government.)  
 T.P. *Asiatic Society of Bengal.* Journal and Proceedings.—Memoirs.  
*Botanical Survey of India.* Records.—Report. (Presented by the Indian Government.)  
 \*T.P. *Calcutta Mathematical Society.* Bulletin.  
*Entomological Meetings (Pusa).* Reports. (Presented.)  
*Ethnographical Survey (Central Indian Agency).* Monographs. (Presented.)  
*Fauna of British India, including Ceylon and Burma.* (Presented by the Indian Government.)  
 T.P. *Geological Survey of India.* Records.—Memoirs.—Palæontologia Indica, etc.  
*Imperial Library.* Catalogue. (Presented.)  
*Indian Assoc. for the Cultivation of Science.* Proceedings.—Bulletin.—Report. (Presented.)  
 P. *Indian Chemical Society.* Quarterly Journal.  
 T.P. *Indian Museum.* Annual Report.—Records.—Memoirs.—Catalogues, etc.  
*Indian Research Fund Association.* Indian Journal of Medical Research.—Medical Research Memoirs. (Presented.)  
*Linguistic Survey of India.* Publications. (Presented by the Indian Government.)  
 T.P. *Meteorological Office, Government of India.* Indian Meteorological Memoirs.—Reports.—Monthly Weather Report.  
*Royal Botanic Garden.* Annals. (Presented.)  
*Scientific Memoirs by Medical Officers of the Army of India.* (Presented.)  
*Survey of India.* General Report.—Professional Papers. (Presented.)

430      Lists of Library Exchanges, Purchases, etc.

P. COIMBATORE—*Agricultural College and Research Institute.*

HYDERABAD—

*Archæological Society. Journal. (Presented.)*

*Osmania University. Nizamiah Observatory. Publications. (Presented.)*

KODAIKANAL—*Observatory. Publications. (Presented.)*

LAHORE—

\*T.P. *University of the Punjab. Department of Zoology.—Memoirs.*

MADRAS—

*Fisheries Bureau. Bulletin.—Reports.*

T.P. *Government Museum. Bulletin.*

*A Descriptive Catalogue of the Sanskrit MSS. in the Government Oriental Manuscripts Library, Madras. 8vo. (Presented by the Government of Madras.)*

T.P. *Literary Society.*

RANGOON. (See BURMA.)

IRELAND (NORTHERN), AND IRISH FREE STATE.

BELFAST—

P. *Natural History and Philosophical Society. Report and Proceedings.*

T.P. *Queen's University Library. Calendar.*

DUBLIN—

*Department of Agriculture and Technical Instruction for Ireland—Fisheries Branch. Reports on the Sea and Inland Fisheries of Ireland (Scientific Investigations).—Geological Survey Memoirs. (Presented by the Department.)*

P. *Dunsink Observatory.*

T.P. *Library of Trinity College.*

T.P. *National Library of Ireland.*

T.P. *Royal Dublin Society. Scientific Proceedings.—Economic Proceedings.*

T.P. *Royal Irish Academy. Proceedings.—Transactions.—Abstract of Minutes.*

ITALY.

BOLOGNA—

T.P. *Accademia di Scienze dell' Istituto di Bologna. Memorie.—Rendiconti.*

\*T.P. *Laboratorio di Entomologia. Bollettino.*

CATANIA—

T.P. *Accademia Gioenia di Scienze Naturali. Atti.—Bollettino Mensile.*

*R. Osservatorio Astrofisico. Annuario.—Catalogo.—Astrofotografico. (Presented.)*

FIUME—*Società di Studi Fiumani. Fiume. (Presented.)*

T.P. GENOA—*Museo Civico di Storia Naturale. Annali.*

MILAN—

T.P. *Reale Istituto Lombardo di Scienze, Lettere, ed Arti. Memorie.—Rendiconti.*

\*T.P. *R. Osservatorio Astronomico di Brera. Pubblicazioni, etc.*

T.P. *Società Astronomica Italiana. Memorie. (To 1919.)*

MODENA—

- T.P. *Regia Accademia di Scienze, Lettere, ed Arti.* Atti e Memorie.  
P. *Società dei Naturalisti.* Atti.

NAPLES—

- P. *Istituto Zoologico della R. Università.* Annuario.  
T.P. *Società Reale di Napoli. Accademia di Scienze Fisiche e Matematiche.*  
Atti.—Rendiconti. *Accademia di Scienze Morali e Politiche.* Atti.—  
Rendiconti. *Accademia di Archeologia, Lettere e Belle Arti.* Atti.—  
Rendiconti.—Memorie.  
T.P. *Stazione Zoologica.* Pubblicazione.  
T.P. PADUA—*R. Accademia di Scienze, Lettere, ed Arti.* Atti e Memorie.

PALERMO—

- P. *Circolo Matematico.* Rendiconti.  
T.P. *Società di Scienze Naturali ed Economiche.* Giornale di Scienze Naturali  
ed Economiche.—Bollettino.  
P. PISA—*Società Italiana di Fisica.* "Il Nuovo Cimento."  
P. PORTICI—*R. Scuola Superiore di Agricoltura.* Bollettino del Lab. di Zoologia.

ROME—

- T.P. *R. Accademia Nazionale dei Lincei.* Memorie.—Rendiconti.—Notizie  
degli Scavi di Antichità. (Atti.)  
T.P. *Accademia Ponteficia delle Scienze Nuovi Lincei.* Atti.—Memorie.  
T.P. *Int. Institute of Agriculture.* Monthly Bulletins.—International Review.  
T.P. *R. Ufficio Geologico.* Memorie descrittive della Carta Geologica.—  
Bollettino.  
T.P. *Società Italiana di Scienza (detta dei XL).* Memorie.  
T.P. *Specola Vaticana.* Publications.

SASSARI—

- P. *Istituto Fisiologico della R. Università di Sassari.* Studi Sassaresi.

TRIESTE—

- P. *Museo Civico di Storia Naturale.* Atti.—Studi Entomologici.  
P. *R. Osservatorio Astronomico.* Rapporto Annuale.  
P. *Società Adriatica di Scienze Naturali.* Bollettino.

TURIN—

- Osservatorio della R. Università. Osservazioni Meteorologiche. (Presented.)*  
T.P. *Reale Accademia delle Scienze.* Memorie.—Atti.  
T.P. VENICE—*R. Istituto Veneto di Scienze, Lettere, ed Arti.* Atti.

JAMAICA.

- P. KINGSTON—*Institute of Jamaica.* Publications.

JAPAN.

FORMOSA—

- P. *Bureau of Forestry.* Icones Plantarum Formosanarum.  
P. *Taihoku Imperial University.* Memoirs, Faculty of Science and Agriculture.  
FUKUOKA—*Kyushu Imperial University.* Mittheilungen.—Acta Medica,  
etc. (Presented.)

482      Lists of Library Exchanges, Purchases, etc.

T.P. KYOTO—*Imperial University (College of Science and Engineering)*. *Memoirs. (School of Medicine)*. *Acta*.—*Japanese Journal of Gastroenterology*.

SENDAI—

T.P. *General Department of Scientific Research, Saito Ho—on Kai*. *Annual Reports*.—*Monographs (Reprint Series)*.

P. *Tôhoku Imperial University*. *Science Reports*.—*Tôhoku Mathematical Journal*.—*Journal of Experimental Medicine*, etc.

T. *Tôhoku Imperial University*. *Library of the College of Medicine*. *Arbeiten aus dem Anatomischen Institut*.

TAIHOKU (See FORMOSA.)

TOKIO—

P. *Asiatic Society*. *Transactions*.

*Central Meteorological Observatory*. *Seismological Bulletin*. (*Presented*.)

P. *Deutsche Gesellschaft für Natur-und Völkerkunde Ostasiens*. *Mittheilungen*.—*Jahresbericht*.

*Earthquake Research Institute*. *Bulletin*.—*Seismological Notes*.—*Reports*. (*Presented*.)

*Imperial Academy*. *Proceedings*. (*Presented*.)

T.P. *Imperial Fisheries Institute (Dept. of Agriculture and Forestry)*. *Journal*.

P. *Imperial Museum*.

T.P. *Imperial University of Tokio*. *Calendar*.—*College of Science*.—*Journal*.—*Medicinische Facultät der K. Japanischen Universität*.—*Mittheilungen*.—*Report of the Aeronautical Research Institute*.—*Journal of the Faculty of Science*, and other publications.

*Institute of Physical and Chemical Research*. *Scientific Papers*. (*Presented*.)

*National Research Council*. *Journals*.—*Proceedings*. (*Presented*.)

P. *Physico-Mathematical Society*. *Acta*.—*Proceedings*.

*University of Literature and Science*. *Science Reports*. (*Presented*.)

P. *Zoological Society of Japan*. *Annotationes Zoologicae Japonenses*.

JAVA.

BATAVIA—

P. *Kon. Natuurkundige Vereeniging*. *Natuurkundig Tijdschrift voor Nederlandsch-Indie*.

T.P. *Magnetical and Meteorological Observatory*. *Observations*.—*Regenwaarnemingen in Nederlandsch-Indie*.—*Verhandelingen*.—*Seismological Bull.*

JUGOSLAVIA.

P. SARAJEVO (BOSNIA).—*The Governor-General of Bosnia-Herzegovina*. *Ergebnisse der Meteorologischen Beobachtungen*.

LATVIA.

RIGA—

T.P. *Systematic Zoological Institute (Latvian University)*.

P. *University*. *Acta*.

LUXEMBOURG.

- P. LUXEMBOURG.—*L'Institut Grand-Ducal*. Archives trimestrielles.

MAURITIUS.

- T.P. *Royal Alfred Observatory*. Annual Reports.—Magnetical and Meteorological Observations, etc.

MEXICO.

MEXICO—

- P. *Instituto Geologico*. Boletin.—Parergones.—Anales.  
 T.P. *Musée National d'Histoire Naturelle*. La Naturaleza (to 1912), etc.  
 T.P. *Observatorio Meteorologico-Magnetico Central*. Boletin Mensual.  
 T.P. *Sociedad Cientifica "Antonio Alzate"*. Memorias y Revista.  
 P. TACUBAYA.—*Observatorio Astronomico*. Anuario.—Boletin.

MONACO.

MONACO—

- Commission Int. pour l'Exploration Scient. de la Mer Méditerranée*.  
 Bulletin. (Presented.)  
 T.P. *Institut Océanographique*. Bulletins.—Résultats des Campagnes Scientifiques.  
 P. *International Hydrographic Bureau*. Hydrographic Review, etc.

NATAL. (See UNION OF S. AFRICA.)

NEW SOUTH WALES. (See AUSTRALIA.)

NEW ZEALAND.

WELLINGTON—

- P. *Dominion Museum and Geological Survey*. Board of Science and Art.  
 N.Z. Journal of Science, etc.  
*New Zealand Government*. Statistics of New Zealand.  
 T.P. *New Zealand Institute*. Transactions and Proceedings.

NORWAY.

BERGEN—

- P. *Geophysical Institute*. Publications.  
 T.P. *Museum*. Aarsberetning.—Aarbog.—Skrifter.—An Account of the Crustacea of Norway. (Now completed.)  
*Report on Norwegian Fishery and Marine Investigations*. (Presented.)

OSLO—

- T.P. *K. Norske Frederiks Universitet*. Nyt Magazin for Naturvidenskaberne.  
 —Archiv for Matematik og Naturvidenskab.  
 T.P. *Meteorological Institute*. Jahrbuch.—Årsberetning, etc.  
*Norske Videnskapsakademi*. Forhandlinger.—Skrifter (Math. Nat. Kl.).  
 (Presented.)

## 434 Lists of Library Exchanges, Purchases, etc.

- P. STAVANGER—*Museum. Aarshefte.*  
 T.P. THRONDHJEM—*Kgl. Norske Videnskabers Selskab. Skrifter.*—Aarsberetning.—Forhandlinger.  
 P. TROMSÖ—*Museum. Aarshefte.*—Aarsberetning.—Skrifter.

### PHILIPPINE ISLANDS.

- P. MANILA—*Bureau of Science. Mineral Resources.*—*Philippine Journal of Science.*

### POLAND.

#### CRACOW—

- T.P. *Académie des Sciences. Rozprawy Wydziału Matematyczno.—przyrodniczego (Proceedings, Math. and Nat. Sciences Cl.).—Rozprawy Wydziału filologicznego (Proc., Philological Section).—Rozprawy Wydziału historyczno-filozoficznego (Proc., Hist.-Phil. Section).—Sprawozdanie Komisji fizyograficznej (Proc., Commission on Physiography).—Geological Atlas of Galicia ; Text, Maps.—Bulletin International, Mémoires, etc.*  
 P. *Société Polonaise de Mathématique. Annales.*

#### LEMBERG—

- T.P. *Société Polonaise des Naturalistes, "Kopernik."*—*Kosmos.*  
 P. *Société Scientifique de Cheutchenko.*

#### WARSAW—

- P. *Fundamenta Mathematicæ.*  
 P. *Société Polonaise de Physique. Comptes Rendus.*

### PORTUGAL.

- T.P. COIMBRA — *University. Anuario.*—*Boletim Bibliographico.* — *Revista.*—*Memorias e Estudos do Museu Zoologico.*  
 LISBON—  
 T.P. *Academia das Sciências de Lisboa. Boletim.*—*Actas.*—*Jornal.*  
 T.P. *Sociedade de Geographia. Boletim.*

### QUEENSLAND. (See AUSTRALIA.)

### ROUMANIA.

#### BUCHAREST—

- T.P. *Academia Romana. Analele.*—*Memoriile.*—*Bulletin de la Section Scientifique.*—Also Publications relating to the History, etc., of Roumania.—*Bibliografia Romanesca.*—*Catalogues, etc.*  
 P. *Institut Météorologique. Buletinul Lunar.*  
 P. *Societatea Română de Stiinte Matematice. Bulletin Mathématique.*

### RUSSIA.

#### KAZAN—

- Société Physico-Mathématique de Kazan. Bulletin. (In abeyance.)*  
*State University. Scientific Journal. (In abeyance.)*

KIEV—*University*. Universitetskiya Isvyaistiya. (*In abeyance*.)

LENINGRAD—

- T.P. *Académie des Sciences*. Mémoires.—Bulletins.—Comptes Rendus.—*Musée Géologique et Minéralogique*. Travaux.  
*Commission Sismique Permanente*. Comptes Rendus.—Bulletin. (*In abeyance*.)
- T.P. *Geological and Prospecting Service*. Bulletins, etc.
- T.P. *Institut de Médecine Expérimentale*. Archives des Sciences Biologiques.  
*Mineralogische Gesellschaft*. Verhandlungen (Zapiski).—Materialien zur Geologie Russlands. (*In abeyance*.)
- T.P. *L'Observatoire Géophysique Centrale*. Annales.—Recueil.
- P. *Physico-Chemical Society of the University of Leningrad*. Journal.
- P. *Russian Amateur Society for the Study of the Universe*. Astronomical Bulletin.—Annual Report.  
*Russian Geographical Society*. (*In abeyance*.)  
*Société Astronomique Russe*. (*In abeyance*.)  
*Société des Naturalistes*. Travaux. (*In abeyance*.)  
*University*. Scripta Botanica. (*In abeyance*.)

MOSCOW—

- \*T.P. *Floating Maritime Scientific Institute*. Berichte.
- \*T.P. *Kossino Biological Station*. Acta.
- P. *Mathematical Society*. Recueil Mathématique.  
*L'Observatoire Astronomique*. Annales. (*In abeyance*.)  
*Observatoire Magnétique et Meteorologique de l'Université*. (*In abeyance*.)  
*Société des Amis d'Histoire Naturelle, d'Anthropologie et d'Ethnographie*. (*In abeyance*.)
- T.P. *Société des Naturalistes*. Bulletin.—Nouveaux Mémoires.  
*University*. (*In abeyance*.)
- T.P. ODESSA—*Wissenschaftl. Forschungs-Institut*. (Central Scientific Library.)  
 Berichte, etc.
- T.P. PERM—*Institut des Recherches Biologiques*. Bulletin.—Mémoires.
- T.P. PETERHOF—*Institut des Sciences Naturelles*. Travaux.
- P. PULKOVO—*Hauptsternwarte*. Publications.
- T.P. SVEDLOVSK—*Société Ouralienne d'Amateurs des Sciences Naturelles*.  
 Bulletin.
- P. TASHKENT—*Central Asiatic University*. Bulletin.
- TIPLIS—*Physikalisches Observatorium*. Beobachtungen. (*In abeyance*.)
- T.P. VERONÉJÉ—*Society of Naturalists*. Bulletin.
- P. VLADIVOSTOCK—*Observatoire Géophysique Central*. Annales.

## SCOTLAND.

ABERDEEN—

- Rowett Research Institute*. Collected Papers. (*Presented*.)
- T.P. *University Library*. Calendar.—University Studies.—Library Bulletin.—  
 Publications.
- BERWICK—*Berwickshire Naturalists' Club*. Proceedings. (*Purchased*.)
- T.P. DUNDEE—*University College Library*.



## EDINBURGH—

- Animal Breeding Research Department. (University.)* Report. (*Presented.*)
- P. *Botanical Society.* Transactions and Proceedings.
- Carnegie Trust for the Universities of Scotland.* Report. (*Presented.*)
- P. *Faculty of Actuaries in Scotland.* Transactions.—Actuarial Students' Magazine.
- Field Naturalists' and Microscopical Society.* Transactions. (*Presented.*)
- P. *Fishery Board for Scotland.*
- P. *Geological Society.* Transactions.
- T.P. *Geological Survey of Scotland.* Memoirs, Maps, etc.
- T.P. *Highland and Agricultural Society of Scotland.* Transactions.
- P. *Mathematical Society.* Proceedings.—Mathematical Notes.
- P. *Meteorological Office, Air Ministry.*
- P. *Pharmaceutical Society (North British Branch).*
- Registrar-General's Returns of Births, Deaths, and Marriages.* (*Presented.*)
- T.P. *Royal Botanic Garden.* Notes.
- T.P. *Royal College of Physicians.*
- P. *Royal College of Physicians' Laboratory.* Laboratory Reports.
- T.P. *Royal Medical Society.*
- T.P. *Royal Observatory.* Annals.—Annual Report.
- T.P. *Royal Physical Society.* Proceedings.
- Royal Scottish Academy.* Annual Reports. (*Presented.*)
- P. *Royal Scottish Geographical Society.* Scottish Geographical Magazine.
- T. *Royal Scottish Museum.*
- T.P. *Royal Scottish Society of Arts.* Edinburgh Journal of Science.
- Scottish Meteorological Society.* Journal. (*Stopped.*)
- T.P. *Scottish National Library.*
- Society of Accountants.* Directory. (*Presented.*)
- T.P. *University Library.* Calendar.

## GLASGOW—

- P. *Geological Society.* Transactions.
- T.P. *Inst. of Engineers and Shipbuilders in Scotland.* Transactions.
- Marine Biological Association of the West of Scotland.* Annual Report. (See MILLPORT.)
- P. *Natural History Society.* Glasgow Naturalist.
- T.P. *Royal Philosophical Society.* Proceedings.
- Royal Technical College.* Calendar.—Journal. (*Presented.*)
- T.P. *University.* Calendar.—Publications (Geology, Physiology, etc.).
- P. *University Observatory.*
- P. MILLPORT—*Marine Biological Association of the West of Scotland.* Annual Report.
- T.P. PERTH—*Perthshire Society of Natural Science.* Transactions and Proceedings.
- T.P. ST. ANDREWS—*University Library.* Calendar.

## SPAIN.

## MADRID—

- T.P. *Instituto Espanol de Oceanografia.* Notas y Resúmenes.—Resultados.—Memorias.

MADRID—continued—

- T.P. *Instituto Geológico y Minero de España.* Boletín.—Memorias.—Notas y Comunicaciones.  
 T.P. *Real Academia de Ciencias Exactas, Físicas y Naturales.* Memorias.—Revista, etc.  
*Universidad. Laboratorio de Investigaciones Biológicas (Cajal).—Trabajos. (Presented.)*  
 P. VILAFRANCA DEL PANADES (CATALUÑA).—*Observatorio Meteorológico.*

SWEDEN.

- P. GOTHENBURG.—*Kongl. Vetenskaps och Vitterhets Samhälle.* Handlingar.  
 T.P. LUND.—*University.* Acta Universitatis Lundensis.  
 STOCKHOLM—  
 T.P. *Kongl. Svenska Vetenskaps-Akademie.* Handlingar.—Arkiv för Zoologi.—Arkiv för Matematik, Astronomi och Fysik.—Arkiv för Botanik.—Arkiv för Kemi. Mineralogi och Geologi.—Meteorologiska Iakttagelser i Sverige.—Astronomiska Iakttagelser.—Lefnadsteckningar.—Arsbok.—Accessionskatalog.—Meddelanden från K. Vetenskaps Akademiens Nobelinstitut.—Les Prix Nobel.  
 P. *Svenska Sällskapet för Antropologi och Geografi.* Ymer.—Geograf. Annaler.  
 T.P. *Sveriges Geologiska Undersökning.* Arsbok.—Översiktskartor.  
 UPSALA—  
 T.P. *Kongliga Vetenskaps Societeten (Regia Societas Scientiarum).* Nova Acta. *Observatoire de l'Université.* Bulletin Météorologique Mensuel. (Presented.)  
*Svenska Västgeografiska Sällskapet.* Acta Phytogeographica Suecica. (Presented.)  
 T.P. *University.* Arsskrift.—Bulletin of the Geological Institution.—Zoologiska Bidrag.

SWITZERLAND.

- T.P. BASLE—  
*Naturforschende Gesellschaft.* Verhandlungen.  
 P. *Société Suisse de Chimie.* Helvetica Chimica Acta.  
*Société Suisse de Physique.* Helvetica Physica Acta. (Purchase.)  
 BERN—  
*Commission Géodésique Suisse.* Arbeiten. (Presented.)  
 P. *Naturforschende Gesellschaft.* Mittheilungen.  
 T.P. *Société Helvétique des Sciences Naturelles.* (Allgemeine Schweizerische Gesellschaft für die gesammten Naturwissenschaften.) Comptes Rendus.—Actes (Verhandlungen).—Nouveaux Mémoires.  
 T.P. GENEVA.—*Société de Physique et d'Histoire Naturelle.* Mémoires.—Comptes Rendus.  
 P. LAUSANNE.—*Société Vaudoise des Sciences Naturelles.* Bulletin.—Mémoires.  
 NEUCHÂTEL—  
 P. *Société Neuchâteloise de Géographie.* Bulletin.  
 T.P. *Société Neuchâteloise des Sciences Naturelles.* Bulletin.—Mémoires.

438      Lists of Library Exchanges, Purchases, etc.

ZURICH—

- T.P. *Commission Géologique Suisse. Beiträge zur geologischen Karte der Schweiz.*  
 T.P. *Naturforschende Gesellschaft. Vierteljahrsschrift.*  
 P. *Schweizerische Botanische Gesellschaft. Berichte (Bulletin).—Beiträge.*  
*Schweizerische Meteorologische Central-Anstalt. Annalen. (Presented.)*  
 T.P. *University.*

TASMANIA. (See AUSTRALIA.)

TRANSVAAL. (See UNION OF SOUTH AFRICA.)

TURKEY.

- P. ISTANBUL.—*Société Turque de Médecine. Gazette Médicale d'Orient.*

UNION OF SOUTH AFRICA.

CAPE TOWN—

- P. *Geological Survey. Annual Reports to 1911.*  
 T.P. *Royal Observatory. Reports.—Annals.—Meridian Observations.—Independent Day Numbers.*  
 P. *Royal Society of South Africa. Transactions.*  
 T.P. *South African Museum. Annals.—Report.—Guide Leaflet.*  
 T.P. *University.*

JOHANNESBURG—

- T.P. *Geological Society of South Africa. Transactions and Proceedings.*  
 P. *South African Association for the Advancement of Science. Journal.*  
*South African Institute for Medical Research. Publications. (Presented.)*  
 T.P. *Union Observatory. Circulars.*

PIETERMARITZBURG—

- P. *Geological Survey of Natal. Annual Reports.—Reports on the Mining Industry of Natal.*  
 T.P. *Government Museum. Annals.*

PRETORIA—

- Dept. of Mines—Geological Survey. Reports.—Memoirs.—Maps. (Presented.)*  
 T.P. *Onderstepoort : Division of Veterinary Services. Reports.*  
*Office of Census and Statistics. Official Year Book. (Presented.)*  
 T.P. *Transvaal Museum. Annals.*

UNITED STATES OF AMERICA.

ALBANY—

- T.P. *New York State Library.*  
*State Museum. Annual Reports.—Bulletin. (Presented.)*  
 P. ALLEGHENY—*Observatory. Publications, etc.*

ANN ARBOR—

- P. *Michigan Academy of Sciences*. Reports.—Papers. (*University*).  
*Museum of Zoology*. Miscellaneous Pubns.—Occasional Papers, etc.  
 (*University*.)

- P. ANNAPOLIS (MARYLAND)—*St John's College*.

BALTIMORE—

- T.P. *Johns Hopkins University*. *American Journal of Mathematics*. —  
*American Chemical Journal* (continued as *Jl. Amer. Chem. Soc.*).—  
*American Journal of Philology*.—*University Studies in Historical and*  
*Political Science*.—*University Circulars*.

- T.P. *Maryland Geological Survey*. Publications.

BERKELEY (CALIFORNIA)—

*Academy of Pacific Coast History*. Publications. (*Presented*.)

- T.P. *University of California*. *University Chronicle*.—Publications.—*Memoirs*.  
 —*Record*.

BOSTON—

- T.P. *American Academy of Arts and Sciences*. *Memoirs*.—*Proceedings*.

- T.P. *Boston Society of Natural History*. *Memoirs*.—*Proceedings*.—Occasional  
 Papers.—*Bulletin*.

- T.P. *Bowditch Library* (*Boston Public Library*).

- P. BROOKLYN—*Institute of Arts and Sciences*. *Museum Reports*.—*Bulletins*.

- P. BUFFALO—*Society of Natural Sciences*. *Bulletin*.

CALIFORNIA. (See SAN FRANCISCO, BERKELEY, MOUNT HAMILTON, MOUNT  
 WILSON, STANFORD, and LA JOLLA.)

CAMBRIDGE—

- T.P. *Astronomical Observatory, Harvard College*. *Annals*.—*Annual Reports*.—  
*Circulars*.—*Bulletins*.—*Reprints*.

- P. *Mass. Institute of Technology*. *Journal of Mathematics and Physics*.

- T.P. *Harvard University*.

- T.P. *Museum of Comparative Zoology*. *Memoirs*.—*Bulletins*.—*Annual Reports*.

- P. CHAPEL HILL (NORTH CAROLINA)—*Elisha Mitchell Scientific Society*. *Journal*.

- P. CHARLOTTESVILLE—*University of Virginia*.

CHICAGO—

- P. *Academy of Sciences*. *Bulletins*.—*Bulletins of the Natural History Survey*.

- T.P. *Field Museum of Natural History*. Publications.—*Annual Reports*.—  
*Memoirs*.

- P. *University of Chicago*. *Oriental Institute Communication*.

- T.P. *Yerkes Observatory* (*University of Chicago*). Publications.

CINCINNATI—

- P. *Observatory* (*University*). Publications.

- P. *Society of Natural History*. *Journal*.

CLEVELAND (OHIO)—

- T.P. *Geological Society of America*. *Bulletins*.

*Nela Research Laboratory*. *Abstract Bulletin*. (*Presented*.)

- T.P. CLINTON (NEW YORK)—*Litchfield Observatory, Hamilton College*.

COLD SPRING HARBOUR, LONG ISLAND (NEW YORK)—*Department of*  
*Genetics, Carnegie Institution of Washington*. (*See WASHINGTON*.)

COLORADO SPRINGS—*Colorado College*. Publications. (*Presented*.)

COLUMBIA—*University of Missouri*. *Studies*. (*Presented*.)

- T.P. CONNECTICUT—*Connecticut Academy of Arts and Sciences. Transactions.*  
—*Memoirs.*
- P. DAVENPORT—*Public Museum. Proceedings Academy of Sciences.*
- P. DENVER (COLORADO)—*Scientific Society of Colorado. Proceedings.*
- T.P. DES MOINES (IOWA)—*Iowa Academy of Sciences. Proceedings.*
- T.P. EASTON (PA.)—*American Chemical Society. Journal.*—*Chemical Abstracts.*  
—*Journal of Indust. and Engin. Chemistry.*
- FLAGSTAFF—*Lowell Observatory. Bulletins. (Presented.)*
- T.P. GRANVILLE (OHIO)—*Denison University and Scientific Association. Journal*  
of the Scientific Laboratories.
- \*T. HUNTINGDON, LONG ISLAND (NEW YORK)—*Vanderbilt Marine Museum.*  
*Bulletin.*
- P. INDIANAPOLIS—*Indiana Academy of Sciences. Proceedings.*
- IOWA CITY—  
P. *Geological Survey. Annual Reports.*—*Bulletin.*
- T.P. *State University, Laboratories of Natural History. Bulletins.*—*Contribu-*  
*tions from the Physical Laboratories.*—*Studies, etc.*
- IOWA. (See DES MOINES.)
- ITHACA (N.Y.)—  
P. *Optical Society of America. Journal.*
- P. The Editor, *Physical Review.* (Cornell University.)
- T.P. LA JOLLA—*Scripps Institution of Oceanography (University of California).*  
*Bulletin.*
- LAWRENCE (KANSAS)—  
*State Geological Survey. Bulletin. (Presented.)*
- T.P. *University of Kansas. Science Bulletin (University Quarterly).*
- P. LINCOLN (NEBRASKA)—*University of Nebraska. Agricultural Experiment*  
*Station. Bulletins.*
- MADISON—  
T.P. { *Wisconsin University. Studies. Washburn Observatory.*—*Publications.*  
*Wisconsin Academy of Sciences, Arts, and Letters. Transactions*  
*(University).*  
*Geological and Natural History Survey. Bulletins (University).*
- P. MASSACHUSETTS—*Tufts College Library. Tufts College Studies.*
- MICHIGAN. (See ANN ARBOR.)
- MINNEAPOLIS (MINN.)—  
T.P. { *University of Minnesota. Studies.*—*Contributions.*—*Bulletin of the*  
*School of Mines.*  
*Geological and Natural History Survey of Minnesota. Bulletin, etc.*
- MISSOURI. (See ST LOUIS, COLUMBIA, and ROLLA.)
- P. MOUNT HAMILTON (CALIFORNIA)—*Lick Observatory. Bulletins.*—*Publica-*  
*tions.*
- T.P. MOUNT WILSON (CALIFORNIA)—*Observatory. Contributions.*—*Reports.*—  
*Communications.*
- NEW HAVEN (CONN.)—  
*Yale University.*—*Memoirs. Astronomical Observatory.*—*Transactions.*—  
\* *Reports.*
- T.P. *Yale University (Peabody Museum of Natural History). Bulletin.*—  
*Occasional Papers of the Bingham Oceanographic Collection.*

NEW YORK—

- American Chemical Society.* (See EASTON, PA.)  
 P. *American Geographical Society.* Bulletin.—Geographical Review.  
 P. *American Institute of Electrical Engineers.* Journal.  
 T.P. *American Mathematical Society.* Bulletins.—Transactions.  
 T.P. *American Museum of Natural History.* Bulletins.—Memoirs.—American Museum Journal.—Annual Reports.—Anthropological Papers.—Guide Leaflets.—Handbook Series.—Monograph Series.—Novitates.  
*Columbia University.* Pubns. (Presented.)  
 \*T.P. *Explorer's Club.*  
*Geological Society of America.* (See CLEVELAND.)  
*Zoological Society.* Zoologica, etc. (Presented.)  
 NEW YORK. (See also ALBANY.)

OHIO (OBERLIN)—

- P. *Math. Assoc. of America.* Amer. Math. Monthly.  
*State University.* American Chemical Society. (See EASTON, PA.)

PHILADELPHIA—

- T.P. *Academy of Natural Science.* Proceedings.—Journal.  
 T.P. *American Philosophical Society for Promoting Useful Knowledge.* Proceedings.—Transactions.  
 P. *Commercial Museum.* Annual Report.  
 P. *Franklin Institute.* Journal.—Year Book.  
 P. *Geographical Society.* Bulletin.  
 T.P. *University of Pennsylvania.* Publications.—Contributions from the Zoological and Botanical Laboratories. University Bulletins.—Theses.  
 P. *Wagner Free Institute of Science.* Transactions, etc.  
 P. PORTLAND (MAINE)—*Society of Natural History.* Proceedings.  
 P. PRINCETON (N.J.)—*University.* Annals of Mathematics.—*University Observatory.* Contributions.  
 PULLMAN (WASHINGTON)—*State College of Washington.* Research Studies. (Presented.)

- P. ROCHESTER—*Academy of Science.* Proceedings.  
 T.P. ROLLA (MISS.)—*Bureau of Geology and Mines.* Biennial Reports, etc.

SAINT LOUIS—

- T.P. *Academy of Sciences.* Transactions.  
 P. *Missouri Botanical Garden.* Annual Reports.—Annals.  
 P. *Washington University.* University Studies.  
 \*T.P. SAN DIEGO—*Society of Natural History.* Transactions, etc.  
 T.P. SAN FRANCISCO (CALIFORNIA)—*Academy of Sciences.* Proceedings.—Memoirs.—Occasional Papers.  
 \*T.P. SEATTLE (WASHINGTON)—*Puget Sound Biological Station.* Publications.  
 P. STANFORD (CALIFORNIA)—*University.* Publications.—Bulletin Terrestrial Electric Observatory, etc.  
 P. TOPEKA—*Kansas Academy of Science.* Transactions.  
 T.P. URBANA—*University of Illinois.* Bulletins of State Geological Survey, State Laboratory of Natural History, and Engineering Experiment Station, etc.

WASHINGTON—

- T.P. *American Association for the Advancement of Science.* Proceedings.  
 T.P. *Bureau of Ethnology.* Annual Reports.—Bulletins.

## WASHINGTON—continued—

- T.P. *Bureau of Standards. Department of Commerce and Labour. Bulletins.*  
—Technological Papers.—Journal of Research, etc.
- T.P. *Carnegie Institution of Washington. Year-Books.—Publications, etc.*  
(T. and P. sent to Department of Genetics, Cold Spring Harbour,  
Long Island, N.Y.)
- T.P. *Coast and Geodetic Survey. Annual Reports, etc.*
- T.P. *Commission of Fish and Fisheries. Reports.—Bulletins.*
- P. *Department of Agriculture. (Division of Economic Ornithology and Mam-  
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*Geological Society of America. (See CLEVELAND.)*
- T.P. *Geological Survey. Bulletins.—Annual Reports.—Monographs.—Geologic  
Atlas of the United States.—Mineral Resources.—Professional Papers.*  
—Water Supply and Irrigation Papers.  
*International Geodetic and Geophysical Union. Bulletin (Sect. Terrestrial  
Magnetism and Electricity). (Presented.)*
- T.P. *National Academy of Sciences. Memoirs.—Proceedings.—National Re-  
search Council.—Bulletin.—Annual Reports.*
- P. *National Museum. Bulletins.—Reports.—Proceedings.—Contributions  
from the U.S. National Herbarium.*
- T.P. *Naval Observatory. Reports.—Publications, etc.*
- P. *Patent Office.*
- T.P. *Smithsonian Institution. Miscellaneous Collections.—Contributions to  
Knowledge.—Reports.—Annals of the Astrophysical Observatory.*
- T.P. *Surgeon-General's Office. Index Catalogue of the Library.*
- T.P. *Washington Academy of Sciences, Journal. (Purchase.)*
- T.P. *Weather Bureau. (Department of Agriculture.) Monthly Weather Review.*  
—Bulletins.—Reports.—Bulletin of the Mount Weather Observatory  
(now embodied in Monthly Weather Review).—Climatological Data.
- WISCONSIN. (See MADISON.)
- T.P. *WOOD'S HOLE (MASS.).—Marine Biological Laboratory. Biological Bulletin.*

VICTORIA. (See AUSTRALIA.)

## II. List of Periodicals and Annual Publications added to the Library by Purchase, etc.

*Periodicals not found in this List will be found in Exchange List.*

*Annals (Works of Reference), see end of List.*

- Acta Mathematica.
- Acta Zoologica.
- American Journal of Science and Arts.
- \* ——— Naturalist. (To 1916.)
- \* ——— Journal of Mathematics.
- \* ——— Chemical Journal.
- \* ——— Journal of Philology.
- Mineralogist.
- Anatomischer Anzeiger.
- Ergänzungshefte.
- Annalen der Chemie (Liebig's).
- der Physik.
- der Physik. (Beiblätter.) (To 1920.)
- Annales de Chimie et de Physique.
- d'Hygiène Publique, Industrielle, et Sociale.
- des Sciences Naturelles. Zoologie.
- des Sciences Naturelles. Botanique.
- Annals and Magazine of Natural History.
- of Botany.
- \* ——— of Mathematics. (Princeton, N.J.)
- Anthropologie (L').
- Arbeiten aus dem Zoologischen Institut der Universität Wien und der Zoologischen Station in Triest. (To 1914.)
- Archiv für Naturgeschichte. (To 1909.)
- Archives de Biologie.
- de Zoologie Expérimentale et Générale.
- des Sciences Physiques et Naturelles.
- Italiennes de Biologie.
- Astronomie (L').
- Astronomische Nachrichten.
- Astrophysical Journal.
- Bericht über die Wissenschaftlichen Leistungen in der Naturgeschichte der niederen Thiere. Begründet von R. Leuckart.
- Bibliotheca Mathematica.
- Bibliothèque Universelle et Revue de Genève.
- See Archives des Sciences Physiques et Naturelles.
- Biologisches Centralblatt.
- Blackwood's Magazine.
- Bollettino delle Pubblicazioni Italiane. (Presented.)
- Botanische Zeitung. (To 1910.)

\* Received by exchange.



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- Botanisches Centralblatt.  
 ———— Beiheft.  
 British Rainfall.  
 Bulletin Astronomique.  
 Bulletin Biologique.  
 ———— des Sciences Mathématiques.  
 ———— Mensuel de la Société Astronomique de Paris. *See L'Astronomie.*  
 Cambridge British Flora. By C. E. Moss.  
 Catalogue of Scientific Papers, 1800-1900 (4to); 1900-1917 (8vo); (Author and partly subject).  
 Centralblatt für Bakteriologie und Parasitenkunde.  
 ———— für Mineralogie, Geologie und Paläontologie.  
 Ciel et Terre.  
 Contemporary Review.  
 Crelle's Journal. *See Journal für Reine und Angewandte Mathematik.*  
 Dictionary, New English. Ed. by Sir J. A. H. Murray. (*Now complete.*)  
 Dingler's Polytechnisches Journal.  
 Discovery. (*To 1929.*)  
 Edinburgh Review. (*Stopped publication.*)  
 Egypt Exploration Fund. Publications. (*To 1919.*)  
 Electrical Engineer, 1888-1911.  
 Electrician. (*To 1917.*)  
 Encyklopädie der Mathematischen Wissenschaften.  
 Engineering.  
 English and Amateur Mechanics. (*To 1926.*)  
 Eugenics Review. (*Presented.*)  
 Fauna und Flora des Golfes von Neapel.  
 Flora.  
 \* Flora Batava.  
 Forestry. Journal of the Society of Foresters of Great Britain. (*Presented.*)  
 Fortnightly Review.  
 Geological Magazine.  
 Göttingische Gelehrte Anzeigen.  
 \* Helvetica Chemica Acta.  
 Helvetica Physica Acta.  
 Indian Antiquary. (*To 1926.*)  
 Institution of Civil Engineers (Abstracts).  
 Intermédiaire (L') des Mathématiciens.  
 International Catalogue of Scientific Literature. *See under Catalogue.*  
 Internationale Revue der Gesamten Hydrobiologie und Hydrographie.  
 Isis.  
 Jahrbücher für Wissenschaftliche Botanik (Pringsheim).  
 Jahresbericht über die Fortschritte der Chemie und verwandter Theile anderer Wissenschaft. (*To 1913.*)  
 Journal de Conchyliologie. (*To 1921.*)  
 ———— de Mathématiques Pures et Appliquées.  
 ———— de Pharmacie et de Chimie.

\* Received by exchange.

Journal des Savants.

—— für die Reine und Angewandte Mathematik (Crelle).

—— für Praktische Chemie.

—— of Anatomy and Physiology.

—— of the Bombay Natural History Society.

—— of Botany.

—— of Pathology and Bacteriology.

—— of Physical Chemistry. (*Exchange stopped 1930.*)

—— of Scientific Instruments.

—— of the Society of Chemical Industry. (*To 1919.*)

—— of the Washington Academy of Sciences.

Manual of Conchology.

Matematisk Tidsskrift.

\* Mathematische und Naturwissenschaftliche Berichte aus Ungarn.

Meteorological Magazine.

Mind.

Mineralogical Magazine. (*Presented.*)

Mineralogische und Petrographische Mitteilungen (Tschermak's).

Monist. (*To 1919.*)

\* Nature.

—— (La).

\* Naturwissenschaften (Die).

Neues Jahrbuch für Mineralogie, Geologie, und Paläontologie.

—— (Beilage).

Nineteenth Century.

Notes and Queries.

Nuova Notarisa (De Toni).

\* Nyt Magazin för Naturvidenskaberne.

Observatory.

Palæontographical Society's Publications.

Petermann's Mitteilungen.

—— Ergänzungsheft.

Philosophical Magazine. (London, Edinburgh, and Dublin.)

\* Physical Review.

Physiological Abstracts.

Plankton-Expedition Ergebnisse.

Prescriber. (*Presented.*)

Proceedings of the Berwickshire Naturalists Club.

Quarterly Journal of Mathematics.

—— of Microscopical Science.

—— of Experimental Physiology.

Quarterly Review.

Quarterly Review of Biology.

Radium. (*Presented.*) (*To 1925.*)

Ray Society's Publications.

Registrar-General's Returns (Births, Deaths, and Marriages). (*Presented.*)

Resultate der Wissenschaftliche Erforschung der Balatonsees.

\* Received by exchange.

- Review of Neurology and Psychiatry. (*To 1919.*)  
 Revue de Géologie (Liège).  
 \* ——— Générale des Sciences Pures et Appliquées.  
 ——— Philosophique de la France et de l'Etranger.  
 ——— Politique et Littéraire. (*Revue Bleue.*) (*To 1926.*)  
 ——— Scientifique. (*Revue Rose.*)  
 \* ——— Semestrielle des Publications Mathématiques.  
 Saturday Review. (*To 1919.*)  
 Science.  
 \* Science Abstracts.  
 \* ——— Progress.  
 Scientia.  
 Scientific American.  
 Scotsman.  
 Scottish National Dictionary.  
 Scottish Naturalist.  
 Tables Annuelles de Constantes et Données Numériques de Chimie de Physique  
 et de Technologie.  
 Thesaurus Linguae Latinæ.  
 Times, and Literary, Engineering, and Educational Supplements.  
 Veterinary Review. (*To 1920.*)  
 \* Zeitschrift für die Naturwissenschaften.  
 ——— für Krystallographie und Mineralogie.  
 ——— für Physik.  
 ——— für Wissenschaftliche Zoologie.  
 Zoological Record.  
 Zoologische Jahrbücher. Abteilung für Anatomie und Ontogenie der Tiere.  
 ——— Abteilung für Systematik, Ökologie und Geographie der Tiere.  
 ——— Abteilung für Allgemeine Zoologie und Physiologie der Tiere.  
 Zoologischer Anzeiger.  
 ——— Jahresbericht. (*To 1912.*)  
 \* Zoologiska Bidrag.

#### ANNUALS (WORKS OF REFERENCE).

- Annuaire du Bureau des Longitudes.  
 Edinburgh and Leith Directory.  
 Engineer's Year-Book. (*Presented.*)  
 English Catalogue of Books.  
 Incorporated Accountants Year-Book. (*Presented.*)  
 Medical Directory.  
 Minerva (Jahrbuch der Gelehrten Welt).  
 \* Nautical Almanac.  
 Newspaper Press Directory.  
 Oliver & Boyd's Almanac.  
 University Calendars:—St Andrews, Edinburgh, Aberdeen, Glasgow, London  
 University College, Birmingham, Belfast, Sydney, N.S.W.; also Calendar of  
 Royal Technical College, Glasgow, etc.

\* Received by exchange.

Wer ist's ?

Whitaker's Almanack.

Who's Who.

Willing's Press Guide.

Year-Book of Scientific and Learned Societies of Great Britain and Ireland.

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**PROCEEDINGS**  
**OF THE**  
**ROYAL SOCIETY OF EDINBURGH.**

IX.—On the Relation of Fertility in Fowls to the Amount of Testicular Material and Density of Sperm Suspension. By F. B. Hutt, B.S.A., Animal Breeding Research Department, University of Edinburgh. *Communicated by Professor F. A. E. CREW.*

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# INTRODUCTION.

STUDIES on fertility in the domestic fowl so far reported have been concerned more with the influence of the female than with that of the male. At the same time it is common knowledge among poultry breeders that there is often a great difference in the fertility of different cocks of the same breed under the same environmental conditions. Such differences are conceivably dependent upon three different factors, these being (1) the frequency of copulations, (2) the number of spermatozoa ejaculated, and (3) the physiological efficiency of the spermatozoa. The present study was undertaken to determine the influence on fertility of the second of these factors.

In attacking this problem it was assumed that the number of spermatozoa elaborated by different males would be dependent to some extent

upon the amount of testicular tissue present. Presumably the same assumption is the basis of the very general objection on the part of breeders of horses, cattle, and other domestic animals to males with only one testis or having one or both testes undersized. While there is considerable variation in the size of testes among normal cocks of the same breed, such differences could be accurately determined only by post-mortem weighing. If normal birds were used, a great number would be necessary to ensure that among them appreciable differences in the amount of testicular material present would be found upon examination at the conclusion of the experiment. Accordingly it was considered that the most suitable material would be cocks which had been castrated in various degrees.

#### MATERIAL.

The males used in the experiment were eleven Single Comb Brown Leghorns hatched in the spring of 1927. The degree of castration in each is shown in Table I.

TABLE I.—MALES TESTED.

Bird Number.	Age at Operation. Days.	Tissue removed.
142	7	Left testis.
152	7	" "
149	7	" "
157	7	Almost all of left testis.
176	14	Right testis. Removed tissue implanted subcutaneously.
5	7	Left testis and about half of right testis.
21	38	Left testis and about half of right testis.
172	12	Left testis and anterior and posterior ends of right testis. Removed tissue implanted subcutaneously under right wing.
382	control	None.
384	control	"
387	control	"

In cases where part of a testis was removed care was taken at the time of operation not to destroy the epididymal connection. These operations were performed by Dr A. W. Greenwood, and to him are due the writer's sincere thanks for the excellent material provided.

The development and growth of these birds were unexceptional, and at six months of age they were indistinguishable in any way from normal males.

The females to which these cocks were mated were mostly Brown Leghorns, but included also some Rhode Island Reds and cross-bred birds, which

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were distributed as equally as possible among the different males. The majority were pullets.

### METHODS.

(a) *Stud Matings*.—The accommodation available did not permit giving each male a separate pen with a flock of females, and therefore the "stud-mating" system was used for the earlier part of the experiment. The cocks were housed in two separate pens, and kept confined till late in the afternoon. Fifty-eight females were used in the first part of the experiment, these being housed in three separate pens, with continual access to an outdoor yard. All were leg-banded and trap-nested. To each male were assigned the leg-band numbers of from five to seven females, and whenever a hen was taken from a trap-nest she was put in a small breeding-coop along with the male indicated by her number. After a period of fifteen or twenty minutes both hen and cock were returned to their original pens.

In assigning the females to the different males care was taken to see that females of different ages and breeds were distributed as evenly as possible among the ten males used for stud mating. The system is open to the criticism that the hen laying six times a week is mated more often than one laying only twice, but since the hens were assigned regardless of their laying ability, the probability of any one male getting a high proportion of good or poor layers among his five to seven hens was not great. The actual records indicated that the chance distribution of frequent layers and poor layers was fair enough to permit comparable tests of the fertility of the various cocks.

All birds were given a grain ration of wheat, oats, and maize; mash of Sussex ground oats, wheat middlings, bran, maize meal, soy-bean meal, and fish-meal, with cabbage occasionally, and oyster-shell *ad libitum*. Milk was supplied irregularly. Cod-liver oil was fed at a level of two per cent. in the mash.

Before records were begun, the females were isolated from males for a period of two weeks, and those laying were not used till their eggs were found, after incubation, to be infertile. Matings were begun on 1st January 1928, and continued till 8th March. Matings with Cocks 172, 176, 157, 382, and 387 were not begun till 27th January owing to there being insufficient laying hens before that date.

All eggs laid after the beginning of the experiment were incubated and examined for fertility by candling in the usual way at five or six days of incubation. All doubtful eggs were broken and the germinal disc examined under a dissecting microscope.

(b) *Flock Matings*.—In a stud-mating system such as has just been described it is obvious that the sexual activity of all males would be appreciably less than if they were at liberty with a flock of the usual fifteen or twenty hens. It was conceivable, therefore, that while the fertility of partially castrated males might compare favourably with that of normal cocks when each male was given only two to five hens per day and sometimes less, it might be different under conditions where sexual activity was unrestricted. Accordingly, three pens of flock matings were established after the termination of the first series in the early part of March. Cocks 149, 5, and 382 were each given free run of a large yard with nineteen, eighteen, and seventeen females respectively. Male 5 had not been previously tested, but both ♂ 149 and the control ♂ 382 had been used in the stud-mating series.

In these flock matings a period of ten days was allowed for fertility to become established, and then all eggs from each pen over a period of from seven to eleven days were incubated and examined as before for fertility. Some of the hens in this series had also been used for stud matings. However, in view of Crew's (1926) findings that on removal of one male and introduction of a second the influence of the first is lost after seven to ten days, it is fairly certain that the ten-day interval allowed in these experiments was ample to ensure that eggs gathered from the eleventh to the twenty-second day indicated only the fertilising power of the second male.

During the course of the experiment samples of semen were obtained and counts made of the spermatozoa therein. At the conclusion of the experiment all males were killed and weights of testes were determined.

#### OBSERVATIONS ON FERTILITY.

In the stud-mating series it was necessary to establish some arbitrary standard for the number of potentially fertile eggs. The work of Crew (1926) and Dunn (1927) indicates that in single matings a fertile egg may rarely be obtained on the first day following mating, but that fertility is well established by the second day. In Dunn's cases fertility was complete and maximum forty-eight hours after mating, but Crew found that with some males the time required for the onset of fertility was three and even five days. In these experiments all eggs laid on or after the third day from the first mating were considered as potentially fertile. The duration of fertility after removal of the male has been shown by the writers quoted and others to decrease after the first week. In these records it was considered that all eggs laid up to five days after the last

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mating ought to be fertile, but any fertile eggs laid after that were also included. Infertile eggs intervening between the first and the last fertile egg counted for any hen were also considered potentially fertile.

The results observed on this basis, in both stud and flock matings, are shown in Table II.

TABLE II.—FERTILITY OF MALES TESTED.

Cock.	Number of Hens.	Potentially Fertile Eggs.	Fertile Eggs.	Fertility per cent.	Days to last Fertile Egg after removing Male.
<i>Stud Matings.</i>					
Experimental :					
21	6	127	91	71.65	18
142	5	119	110	92.44	9
152	6	119	86	72.27	10
149	7	118	98	83.05	7
172	6	67	54	80.59	12
176	5	53	35	66.04	7
157	5	58	41	70.69	
			Average*	76.67	
Controls :					
382	6	64	47	73.44	11
387	5	62	48	77.42	13
384	7	100	80	80.00	13
			Average*	76.95	
<i>Flock Matings.</i>					
Experimental :					
5	18	84	72	85.71	
149	19	126	117	92.85	
Control :					
382	17	47	33	70.21	

\* I.e. the average fertility of the cocks, not of the potentially fertile eggs.

It is evident that in the stud matings the fertility of partially castrated cocks was equally as good as that of normal cocks, the averages for the two groups being, by a coincidence, practically equal. In the flock matings ♂ 149 gave better fertility than when stud-mated, and both his record and that of the previously untested ♂ 5 were excellent. The one control cock gave slightly lower fertility than in stud matings, but this was probably due to a chance difference in the smaller number of eggs tested from his pen. The duration of fertility after removal of the male was on the average practically as long in the experimental group as in the controls.

Table III presents a biometrical analysis of the individual performances of the females in the stud-mating series.

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TABLE III.—STATISTICAL CONSTANTS FOR FEMALES IN THE STUD-MATING SERIES.

Class.	Number of Individuals.	Mean Fertility and Probable Error per cent.	Standard Deviation and Probable Error per cent.
Experimental . . . . .	40	76.45 ± 2.38	22.33 ± 1.68
Control . . . . .	18	76.22 ± 2.76	17.41 ± 1.95

It is evident that there is no significant difference between the mean fertility in each group. The difference in the standard deviations is  $4.93 \pm 2.37$ . Since this difference is only 2.08 times its probable error, it is not statistically significant. It may therefore be concluded that the results are not affected by any undue variability of the females in either group.

### SPERMATOZOA COUNTS.

The hypothesis suggested by these results, namely, that fertility of the male is entirely independent of the amount of testicular tissue present, could not be proved until that tissue had been weighed after death. Both Benoit (1925) and Domm and Juhn (1927) found a compensatory hypertrophy of the remaining testis following unilateral castration of young chicks. It was therefore to be expected that compensatory hypertrophy would take place to an unknown extent in some or all of the material used in this experiment. An attempt had been made to prevent such hypertrophy in ♂ 172 by grafting subcutaneously the portions of testis removed at the time of operation. If the compensatory hypertrophy were occasioned by the demand for production of a certain degree of physiological activity of the testis this demand might be met (and hypertrophy prevented) by a functioning testis in any part of the body, while obviously only the testicular material in communication with the vas deferens would be available for reproduction. Nevertheless, the amount of testis in any of the males was entirely unknown. To determine whether or not the density of sperm suspension in the semen bore any relation to the size of testis, or could be accepted as a measure of potential fertility in mating, an examination was made of thirty-six samples of semen from ten different males.

(a) *Collection of Semen.*—Determinations of the density of sperm suspension in semen of the fowl have been previously made by Payne (1914) and Craft, McElroy, and Penquite (1926). These workers obtained their samples from the cloaca of the hen after coitus, and it is therefore



difficult to see how a certain amount of dilution of semen by fluids in the cloaca could have been avoided. Since this method was hardly accurate, an attempt was made in the present study to secure normal semen from the ejaculate.

It was found that after the cocks had become accustomed to being handled and had been used in stud matings for over a week, they would readily copulate when a willing female was introduced, regardless of the presence of an observer. With a little practice it was possible to intercept the ejaculate and collect it in a watch crystal. By using this method, samples were obtained from the ten cocks stud-mated. Male 5, which was used only for flock matings, could not be induced to copulate when confined in a small coop with an observer present, and therefore no semen was obtained from him.

(b) *Technique of Counting.*—The densities of the sperm suspensions in the semen were determined with a Thoma-Hawksley hæmacytometer having a depth of 0.10 mm. Ringer's solution, to which had been added 3.5 per cent. of formalin, was used as a diluting fluid and gave excellent results. Without any formalin, movement of the spermatozoa was not arrested, so that accurate counting was difficult. More than 3.5 per cent. formalin caused the sperms to curl up and become more difficult to see and to distinguish from minute masses of debris. For each sample counts were made of 160 out of the 400 squares ruled off on the hæmacytometer.

"Student" (1907) has demonstrated that when the technique of dilution and counting is accurate, the distribution of yeast cells on the squares of a hæmacytometer conforms to a Poisson Series. Moreover, Fisher (1925) points out that the standard error of a random sample from such a distribution is  $\pm \sqrt{m}$ , where  $m$  (the number of cells counted) is a large value. The same error should apply to any large hæmacytometer count if the technique be accurate. Two or three counts of the same dilution of semen were compared on several occasions. It was found that the deviations from the mean were within the standard error in most cases, and in no case significantly greater than the limits of that error. It may, therefore, be considered that the technique used was satisfactory, and that the counts reported below are accurate measurements of the density of sperm suspension in the various samples of semen examined.

It was found that the numbers of spermatozoa per cubic millimetre varied somewhat between different individuals, but even more in samples from the same individual secured following various degrees of sexual

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activity. Thus, on 30th March the first sample for several days from ♂ 142 contained 5,500,000 sperms per cu. mm. After forty minutes' freedom with a hen, a sample was again obtained which contained 1,690,000 per cu. mm. The cock was left with another hen for forty-five minutes, and a sample secured thereafter had only 277,600 per cu. mm. Accordingly an attempt was made to secure representative samples from each male, *i.e.* after similar degrees of sexual activity. This presented some difficulty because of the unwillingness to copulate on the part of some of the males after one or two previous matings. In most cases this could be overcome by leaving the cock with one hen for an hour or so, then removing her and introducing another hen of a different colour, but with others a similar artifice was unsuccessful (*e.g.* ♂ 149). The data in Table IV give the average number of spermatozoa per cu. mm. in representative samples from each male, including in each case (except ♂ 149) the first ejaculation of a day, and two or more other semen samples taken after various degrees of sexual activity.

TABLE IV.—SPERMATOZOA COUNTS, TESTIS WEIGHTS, AND FERTILITY.

Bird Number.	Body Weight (grams).	Testis Weight (grams).			Ratio Body Wt. Testis Wt.	Spermatozoa.		Fertility.	
		R.	L.	Total.		Samples.	Av. No. p. cu. mm.	Flock.	Stud.
Experimental:									
21	1927	5.77	...	5.77	333.9	4	1,782,650	...	71.6
142	1843	15.95	0.55	16.50	111.7	7	1,836,650	...	92.4
152	1757	24.00	...	24.00	73.2	3	825,960	...	72.2
149	1786	13.59	...	13.59	131.4	1	5,300,000	92.8	83.0
172	1814	8.98	...	8.98	202.0	2	5,032,500	...	80.0
176	1474	...	10.52	10.52	140.1	5	3,994,380	...	86.0
157	1956	15.55	0.94	16.49	118.6	4	7,328,500	...	70.6
5	1360	1.06	3.51	4.57	297.6	...	...	85.7	...
Average: 1740		...	...	12.55	201.1	...	3,728,663	89.2	76.6
Controls:									
382	1843	9.82	8.54	18.36	100.4	4	3,615,000	70.2	73.4
387	1814	6.07	8.00	14.07	128.9	3	4,848,667	...	77.4
384	1672	6.22	4.83	11.05	151.3	3	5,425,333	...	80.0
Average: 1776		...	...	14.49	126.8	...	4,629,667	...	76.9

## WEIGHTS OF TESTICULAR MATERIAL.

In the same table are given the weights of testes found in each fowl at post-mortem examination. Only that tissue is included which was in communication with the vasa deferentia, as evidenced by active sperm being found in these ducts. In one or two cases small nodules of testes had regenerated after the operation but were not in communication with the vas and so are not included.

## INTERPRETATION OF RESULTS.

(a) *Fertility in Relation to Size of Testis.*—Inspection of Table IV shows that while the testis size and spermatozoa counts of the controls were on the average slightly higher than in the experimental males, the average fertility was practically identical in each group in the stud matings. In the flock matings the two partially castrated cocks excelled the control. The latter bird did no better in flock matings than in stud matings, while ♂ 149 showed considerable improvement.

It is particularly significant that ♂ 5, tested only in flock matings, yielded a fertility of 85.7 per cent., a figure excelled by only two of the whole eleven males, in spite of the fact that he had only 4.57 grams of testis material. Male 172, with 8.98 grams of testis, gave 80 per cent. fertility. In contrast to these, ♂ 152, with 24 grams of testis, gave only 72.2 per cent. fertility. Cock 157, with 16.49 grams of testis, secured only 70.6 per cent. fertility; while ♂ 142, with exactly the same amount of testicular material, induced 92.4 per cent. fertility.

From these data it is reasonably certain that within the ranges covered by the eleven males tested (i.e. fertility from 66 per cent. to 92 per cent. and testis from 4.5 to 24 grams) fertility is entirely independent both of the absolute amount of testicular tissue present and of the amount in proportion to body weight.

(b) *Fertility in Relation to Density of Sperm Suspension.*—It is also evident that within the same limits of fertility a density of sperm suspension ranging from 825,960 per cu. mm. to nine times that figure has no relation to the resultant fertility. Thus Cocks 142 and 157 had equal amounts of testicular tissue, but while the former had an average sperm count of 1,836,650 and 92.4 per cent. fertility, the latter had an average count of 7,328,500 and a fertility of only 70.6 per cent. Similarly the fertility of ♂ 152 and of ♂ 382 was practically the same, although the number of sperm cells per cu. mm. was four times as great in the semen of the latter as in the former. The cock giving the lowest fertility in

the stud-mating series had over twice as many sperms per cu. mm. of semen as the cock with the highest fertility in the same series—♂ 142.

Walton (1927) found that with rabbits, a sperm suspension of less than 1,000,000 in 3 c.c. resulted in reduced fertility, and that below 10,000 in 3 c.c. sterility occurred. Possibly the same dilutions might produce similar results in the fowl if only one insemination were made. However, since for none of the ten cocks examined was the average density of sperm suspension less than *eight hundred times* Walton's critical figure, and in all but one it was *over one thousand times that figure*, it is extremely doubtful if in normal cocks density of sperm suspension is a factor contributing to the differential fertility often observed. Moreover, insemination in the fowl occurs not just once as in rabbits, but is repeated in an irregularly continuous manner often several times daily.

It is quite conceivable, however, that in certain pathological conditions the density of sperm suspension may become so low as to affect fertility. It is quite probable that the partial sterility observed in the first breeding year of Gowen's (1926) case of a fowl with cystic testes, reflected a degree of that occlusion of the vasa deferentia which post-mortem examination revealed had later become complete. In such cases one would expect a sperm suspension low enough to affect fertility even if the sperm were physiologically normal.

The extremely high average sperm count and the low fertility of ♂ 157 may have both resulted from a mild cloacitis with which he was affected throughout the entire breeding season. It is perhaps possible that the local irritation may have induced hyper-active spermatogenesis. No great difference in motility or appearance of his spermatozoa was evident when compared with those of others.

In view of these findings, it seems reasonable to infer that the differential fertility of cocks is dependent (except in cases of obviously unwilling breeders) upon differences in the physiological efficiency of the spermatozoa. No difference in motility of sperm cells from the ten cocks was noticed, but it was observed that the motility depends to a marked extent upon the temperature of the semen when examined.

Williams and Savage (1925) have shown that even a small proportion of certain types of abnormal sperms in the semen of bulls indicates low fertility. In a later paper Savage, Williams, and Fowler (1927) have also shown that the breeding efficiency of an unsound bull can be detected by measuring the head lengths of a representative sample of spermatozoa, determining the statistical constants for the distribution and the degree

of skewness of the curve of frequency distribution. A coefficient of variation greater than certain physiological limits or a statistically significant skewness indicated a poor breeder. Such results were usually confirmed by cytological and clinical findings, but in some cases of low fertility no evidence of unsoundness was found except by the statistical analysis of head lengths of spermatozoa. This means that a great variation in size of sperm, or a certain proportion of large or small cells, indicates some unknown condition which results in poor breeding efficiency. It is probable that similar conditions apply in the case of the fowl.

(c) *Amount of Testis and Density of Sperm Suspension*.—Contrary to expectation, the density of sperm suspension does not appear to bear any definite relation to the size of testis. In the first ejaculations of the day, or after a rest period of several days, practically no difference was observed between the counts of control and experimental males. It was only after being allowed to copulate several times that variations became marked. Such differences were not necessarily in accord with the amount of testis tissue present, although the decrease was less marked in the control males. For example, the lowest count obtained was one of 18,700 per cu. mm. from ♂ 152 after he had been 1½ hours with a hen. After a longer period at liberty with two different hens ♂ 142 gave a count of 277,600. The latter had 16.5 grams of testes, the former 24. Such a difference may, of course, reflect only different degrees of activity, but in this case both were keen breeders. In general, the slightly lower average counts of experimental cocks from which three or more samples were obtained reflect reduced counts following sexual activity, this reduction being equally apparent in cocks with a large but unilateral testis (e.g. ♂ 152) as in those with less testicular tissue.

The data of Craft *et al.* (1926), when re-arranged, also indicate that the density of sperm suspension is not dependent upon the size of testis (Table V). The counts made by these workers are much below those observed by the writer. Nevertheless it is probable that the degree of error in them (*vide infra*) was approximately the same in each case, especially since the number of samples from each pen (of three White Leghorn yearling cocks) ranged from eight to twenty-two, and that therefore the average counts are comparable one with another.

It seems probable that the density of sperm suspension in the semen is a reflection more of the degree of spermatogenic activity than of testis mass, and that at any one season differences in this activity depend upon the individual peculiarities of different birds as well as upon environmental conditions.

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TABLE V.—RELATION OF AMOUNT OF TESTICULAR TISSUE TO THE DENSITY OF SPERM SUSPENSION IN THE SEMEN.

(Rearranged from data of Craft, McElroy, and Penquite.)

Pen.	No. of Males.	Samples counted.	Average No. Spermatozoa per cu. mm.	Average Total Testis Weight (grams).
1	3	7	105,400	22.30
2	3	20	177,500	10.80
3	3	12	225,300	13.46
4	3	11	224,900	17.01
5	2	8	96,500	12.17
6	3	10	676,000	22.66

Polowzow (1927) has recently shown that the rhythm of sperm production in the horse differs in different individuals besides being influenced by the frequency of breeding and length of rest periods.

(d) *Average Sperm Counts*.—The individual counts observed by Craft, McElroy, and Penquite ranged from 2000 to 4,000,000 per cu. mm. The semen was collected from the cloaca of the female *post coitu*, usually from the first matings in the morning. Since, in the present work, samples taken at this time were much higher than those taken after several matings, the writer is of the opinion that the low average counts of Craft *et al.* indicate that their samples were somewhat diluted by fluids of the cloaca. The determinations made in the present experiment ranged from 18,700 to 8,864,000 per cu. mm., with an average of 4,015,088 for 36 counts. The average counts for individual males ranged from 825,000 to 7,328,500, with an average of 3,998,642 for each of the ten cocks tested. Payne (1914) found that the density of sperm suspension in the semen of five different cocks ranged from 1,920,000 to 5,470,000 per cu. mm., with an average of 2,928,000. These figures are in accord with those observed in this experiment.

(e) *Amount of Ejaculate*.—It was found exceedingly difficult so to improve upon the method of collecting semen used in the present study that one could always secure the entire ejaculate. It was also difficult to measure the exact volume of the very small samples invariably obtained; the weight, however, could be accurately determined. The weights of eight samples of semen definitely known to contain the entire ejaculate are given in Table VI.

These data merely indicate that there is considerable variation in the amount of the ejaculate of different individuals and of the same individual

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at different times. It is also apparent that the density of sperm suspension is independent of the amount of ejaculate. The available data do not permit of any statement concerning the relation between the total number of sperms ejaculated and fertility.

TABLE VI—WEIGHT OF EJACULATE WITH CORRESPONDING SPERM COUNTS.

♂.	Ejaculate (grams).	Sperm per cu. mm.
152	0.079	787,200
152	0.184	...
157	0.124	8,864,000
176	0.036	5,935,200
142	0.055	564,800
383	0.067	2,720,000
"	0.141	5,962,000
"	0.217	5,864,000
Average :		0.113

(f) *Compensatory Hypertrophy*.—With regard to compensatory, hypertrophy, it is evident (Table IV) that in males 142, 152, 149, and 157 the retained testis had hypertrophied to an extent approximately equivalent to the combined weight of both testes in the three controls. Indeed, in ♂ 152 the remaining testis was larger by 5.64 grams than the total testis material in the largest control pair. In another cock (♂ 147) unilaterally castrated at sixteen days, but untested for fertility owing to shortage of females, the retained right testis was found on autopsy thirteen months after the operation to be 17.1 grams. The results in this case are uniform with those of the other four.

In general these findings agree with those of Benoit (1925) and Domm (1927), but they differ from the latter's results in one important particular. Domm found that unilateral castration of birds 16, 24, or 40 weeks of age resulted in compensatory hypertrophy of the retained gonad whether right or left was removed, but that if one testis were removed from a week-old chick, compensatory hypertrophy resulted only when the left testis was retained and *not when the right one remained*. In all of the five birds mentioned above compensatory hypertrophy of the *right* testis was manifest to an extent approximating the normal weight of two testes.

On the other hand, the right retained testis of ♂ 21, operated on at five weeks of age, did not hypertrophy at all, and represents exactly what was left at the operation, i.e. half of a testis. Similarly ♂ 5, from whom

the left testis and half of the right were removed at seven days of age, had only 1.06 grams of testis on the right side at post-mortem but had regenerated a 3.51 nodule of testis tissue on the left. Neither the data now presented nor those of the other two workers afford a satisfactory explanation of why there should not have been hypertrophy in these two cases to the same extent as in the others. The theory suggests itself that mutilation of the surviving testis may prevent its hypertrophy, but the numbers are too small to substantiate the theory.

Cocks 172 and 176 present another aspect of the case. Both these birds were operated upon at twelve to fourteen days (Table I), but the tissue removed was grafted subcutaneously under the wing. These grafts persisted and were present at autopsy over a year after the operations. That of ♂ 172 was 2.41 grams, while ♂ 176's graft was only 0.125 gram. In neither of these cases was there any distinct evidence of hypertrophy (see Table IV). Another cock, untested for fertility (♂ 162), fell in the same class with a retained right testis of 7.58 grams, and an unweighed testis graft 1.9 cm. × 1.5 cm.

While the present data support the previous workers' establishment of the occurrence of compensatory hypertrophy, they are not sufficient to account for that phenomenon. The obvious assumption is that a certain amount of testis tissue is necessary to maintain the balance between different organs of the body. Nevertheless, some of the cases reported above have matured and reproduced in every respect like normal males, yet had only about half of a normal testis. The fact that hypertrophy was not evident in the three birds carrying grafts suggests that the balancing action of the testis calls for production of an optimum amount of testicular hormone, and that if this be in part supplied from a graft the testis retained need not hypertrophy. However, the grafts of these birds, plus retained testis, did not amount to much more than a single normal testis.

#### SUMMARY.

1. Fertility tests of eight partially castrated cocks and three controls show that within quite wide limits of fertility and of testis size the fertility of the male fowl is not in any way dependent upon size of the testis.

2. The average density of sperm suspension was found to be approximately four million spermatozoa per cubic millimetre for the thirty-six samples examined from ten males.

3. The variations in the average density of sperm suspension from



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different birds ranged from 825,000 to over 7,000,000 cells per cu. mm., but within this range the density of sperm suspension bore no relation to fertility.

4. The number of sperm per cubic millimetre of semen appears to be entirely independent of the size of the testes within the ranges covered by this experiment.

5. Compensatory hypertrophy to a degree approximating to the normal weight of both testes was observed in the retained right testes of cocks castrated unilaterally on the left side at one week of age.

6. Exceptions to the rule of compensatory hypertrophy included birds with subcutaneous testis grafts and two in which one whole testis and part of the other had been removed.

7. It is suggested that fertility in the male fowl is dependent upon the physiological efficiency of the spermatozoa rather than upon their quantitative production.

ACKNOWLEDGMENTS.

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REFERENCES.

BENOIT, J. (1925), "Sur la Hypertrophie Compensatrice après Castration unilaterale chez le Coq domestique," *Compt. Rend. de l'Acad. Sci.*, vol. clxxx, pp. 1690-92.

CRAFT, W. A., C. H. McELROY, and ROBERT PENQUITE (1926), "The Influence of Certain Feeds upon the Production of Spermatozoa by the Domestic Chicken," *Poult. Sci.*, vol. v, pp. 187-98.

CREW, F. A. E. (1926), "On Fertility in the Domestic Fowl," *Proc. Roy. Soc. Edin.*, vol. xlv, pp. 230-38.

DOMM, L. V., and MARY JUHN (1927), "Compensatory Hypertrophy of the Testis in Brown Leghorns," *Biol. Bull.*, vol. lii, pp. 458-73.

DUNN, L. C. (1927), "Selective Fertilisation in Fowls," *Poult. Sci.*, vol. vi, pp. 201-14.

FISHER, R. A. (1925), *Statistical Methods for Research Workers*, Edinburgh, Oliver & Boyd.

GOWEN, JOHN W. (1926), "Cystic Testes. A Cause of Male Sterility in the Domestic Fowl," *Poult. Sci.*, vol. v, pp. 146-48.

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PAYNE, L. F. (1914), "Vitality and Activity of Sperm Cells and Artificial Insemination of the Chicken," *Oklahoma Exp. Stat. Circ.*, No. 30

POLOWZOW, WERA (1927), "Die Spermatozoen produktion beim Pferde I. Mittellung. Über den Einfluss der häufigen Kohabitationen auf den Spermienproduktion," *Pflügers Arch. f. gesamte Phys. des Mensch. u. d. Tiere.*, vol. ccxviii, pp. 374-85.

SAVAGE, A., W. W. WILLIAMS, and N. M. FOWLER (1927), "A Statistical Study of the Head-length Variability of Bovine Spermatozoa and its Application to the Determination of Fertility," *Trans. Roy. Soc. Canada*, vol. xxxi, sect. 5, pp. 425-50.

"STUDENT" (1907), "On the Error of Counting with a Hæmacytometer," *Biometrika*, vol. v, pp. 351-60.

WALTON, A. (1927), "The Relation between 'Density' of Sperm Suspension and Fertility as determined by Artificial Insemination of Rabbits," *Proc. Roy. Soc., B*, vol. ci, pp. 303-15.

WILLIAMS, W. W., and A. SAVAGE (1925), "Observations on the Seminal Micro-pathology of Bulls," *Cornell Veterinarian*, vol. xv, pp. 353-75.

(Issued separately March 27, 1929.)



To test this hypothesis in respect of the Brown Leghorn, a breed which exhibits sex-dimorphism in the plumage, an attempt was made in the spring of 1927 to thyroidectomise a number of females. Further, in order to ascertain whether, if an effect were obtained, this would be reciprocal to that produced by thyroid feeding, the operation was also performed on males and capons. In addition, two normal males and females were fed daily with thyroid so that we might be in a better position to interpret the previous work on experimental hyperthyroidism in this breed.

On completion of these experiments it was found that the conclusions based on the results obtained gained both confirmation and amplification from a study of the plumage changes occurring in some contemporary series of experiments with Brown Leghorns. Accordingly it has been decided to devote a section in the present communication to the analysis and significance of the feather changes which appeared in these groups.

#### PART I.—THYROIDECTOMY.

*Material and Technique.*—The breed of the Domestic Fowl known as the Brown Leghorn was chosen as the most suitable material for this investigation on account of the extreme dimorphism of the plumage in the two sexes, both in regard to pigmentation and to structure of the feathers. Newly hatched chicks were bought from a reputable breeder and reared in the laboratory.

The age at which the chicks were operated on varied from 32 to 80 days after hatching. The operation for the removal of the thyroid gland was found to be extremely difficult owing to its close attachment to the jugular veins. The gland consists of two lateral pinkish lobes, oval and about 0.5 cm. in their longest diameter; they are situated, one on either side of the neck, internal to the jugular vein and near the junction formed by the divergence of the subclavian and common carotid arteries.

The chick, while under a deep anaesthesia, was laid on its back and incisions made in the skin from the point of the keel along the line of the furcula on both sides, this area having previously been bared of feathers. For the removal of the right thyroid it was necessary to sever the connections of the crop to the muscles and skin. The cervical air-sac membrane was then incised and the thyroid lobe exposed. Two different methods for the removal of the gland were attempted. In the first, the capsule of the gland was incised and the

thyroid tissue removed with forceps, this method could not be completely successful, in that the gland invariably fractured, and the removal of the remaining fragments was rendered extremely difficult by hæmorrhage obscuring the site of the operation. It was ultimately decided that the method most likely to offer success was one in which

TABLE I.

Number of Bird.	Sex.	Age at Operation.	Operation.
11	♀	50 days	Left thyroid removed.
15	♀	47 "	Half left thyroid removed.
		50 "	Right thyroid removed.
30	♀	32 "	Left thyroid removed.
		35 "	Two-thirds right thyroid removed.
34	♀	46 "	Both thyroids removed.
35	♀	39 "	" " "
76	♀	72 "	" " "
86	♀	63 "	" " "
106	♀	63 "	" " "
115	♀	58 "	" " "
33	♀	8 "	Ovariectomised (incompletely).
		80 "	Both thyroids removed.
72	♀	4 "	Ovariectomised (incompletely).
		66 "	Both thyroids removed.
37	♂	39 "	Right thyroid removed.
		44 "	Left thyroid removed.
57	♂	39 "	Right thyroid removed.
		44 "	Left thyroid removed.
81	♂	38 "	Both thyroids removed.
60	♂	42 "	" " "
		51 "	Castrated.
27	♂	34 "	Left thyroid removed.
		34 "	Castrated.
116	♂	37 "	Both thyroids removed.
		40 "	Castrated.
99	♂	47 "	" " "
		51 "	Right thyroid and thymus removed.
		52 "	Left thyroid and thymus removed.
169	♂	17 "	Castrated.
		37 "	Right thyroid and thymus removed.
		38 "	Left thyroid and thymus removed.

the gland could be completely removed in one movement. To this end the gland was held by claw-toothed forceps and removed by a quick cut with scissors between the thyroid and the jugular vein. If the thyroid was not then completely removed, the subsequent hæmorrhage prevented the satisfactory removal of the remaining fragments. The hæmorrhage resulting from the operation was in most cases easily controlled. In some cases both thyroid lobes were removed the same day, in others, where hæmorrhage had been somewhat severe, a rest

period of a few days seemed desirable before an attempt was made to remove the other lobe. With the exception of two or three birds, to be referred to specifically later, recovery from the immediate effects of the operation was uneventful. In Table I the list of birds operated upon is given. It will be noted that in 15 of the birds complete thyroidectomy was attempted, while in the other 4 cases only part of the thyroid tissue was removed. Adequate controls were kept of all the classes of operated birds.

Following the operation the birds were under close observation, particularly in regard to the plumage, but also the growth, time of attainment of sexual maturity, fertility, and the average weight of eggs laid, were noted in operated and control birds. The conditions of feeding and husbandry were similar both in the operated and in the control groups.

In these experiments the thyroid lobes were removed without conscious interference with the parathyroid glands. In many cases this presents no difficulty, since the parathyroids are separate from and posterior to the thyroid lobes. Even where the parathyroids are closely approximated to the thyroid, they have not been seriously interfered with, as post-mortem examination of all the operated birds always revealed the presence of adequate amounts of parathyroid tissue on both sides.

#### RESULTS.

*Effect of the Operation on Growth.*—All the birds in the experiment were weighed at fortnightly intervals, and the weighings, begun at the time of the operation, were continued until thirty-eight weeks from the date of hatching. At this point when most of the operated females had begun laying, the weighings were discontinued. In Table II the absolute weights of the operated and control birds are given. For the sake of brevity only monthly average weights are shown.

Consideration of the table shows that at maturity those birds of both sexes in which complete thyroidectomy had been attempted, exhibited the lowest weights of all the classes. The partially thyroidectomised birds, on the other hand, are apparently not adversely affected by the operation, since at the end of the thirty-eighth week period they weigh as much as the controls. It will be seen by reference to the weights in the earlier part of the table that for the first few weeks immediately succeeding the operation the weights are somewhat lower than the control weights.

To determine whether this earlier retardation in the growth is due solely to the operative interference, the table includes a series of weights of

castrated males and partially ovariectomised females. Since both these operations require somewhat prolonged anaesthesia and are accompanied by some hæmorrhage, they can be considered as equivalent to the operation for thyroidectomy from the point of view of immediate effect consequent upon the surgical interference. It will be seen that the weights of the castrated males and partially thyroidectomised, castrated males are similar, the superimposition of the thyroid operation resulting in no further retardation of growth. In the females, however, apparently the recovery from the operation of partial thyroidectomy is more prolonged than in the case

TABLE II.

No. of Birds.	Sex.	Class.	Age in Weeks.							
			10.	14.	18.	22.	26.	30.	34.	38.
3	♂	Controls . . . . .	Gms. 720	Gms. 1220	Gms. 1520	Gms. 1720	Gms. 1860	Gms. 1930	Gms. 1990	Gms. 2100
5	♂	Castrates . . . . .	700	1170	1470	1690	1890	1910	1980	2070
2	♂	Thyroidectomised . . . . .	550	900	1220	1360	1470	1490	1590	1670
1	♂	Partially thyroidectomised. Castrated. . . . .	620	1170	1530	1690	1790	1930	2010	2100
1	♂	Thyroidectomised. Castrated. . . . .	570	910	1130	1470	1530	1700	1810	1810
2	♂	Thyroidectomised. Castrated. Thymectomised. . . . .	480	850	1010	1220	1290	1420	1490	1550
20	♀	Controls . . . . .	570	860	1080	1160	1260	1390	1460	1560
27	♀	Partially ovariectomised . . . . .	600	880	1060	1180	1290	1420	1540	1560
2	♀	"Thyroidectomised". . . . .	540	720	980	1050	1110	1230	1350	1420
3	♀	Partially thyroidectomised . . . . .	480	780	1060	1150	1280	1370	1490	1590
5	♀	Thyroidectomised . . . . .	450	670	920	1060	1160	1300	1420	1450

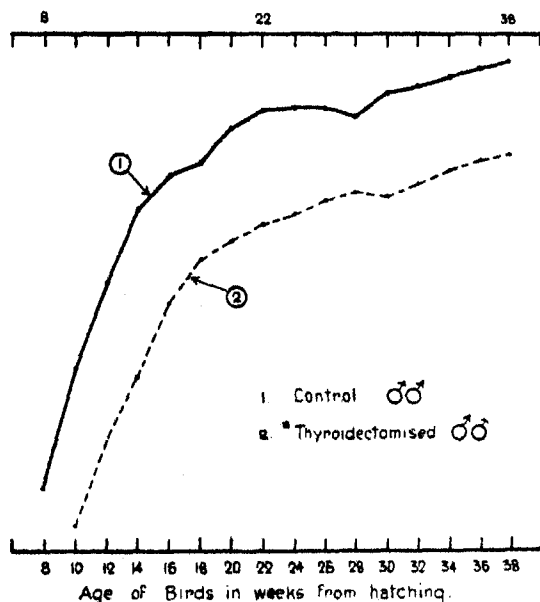
of partial ovariectomy, but the significance of this is negated by the fact that the operations for ovariectomy were performed at an earlier age than that for partial thyroidectomy. Those birds of both sexes in which complete thyroidectomy has been attempted have weights significantly lower than the normal for the whole of the growth period.

The growth rates of some of the different classes of birds have been plotted. It will be seen, when the growth rate of thyroidectomised \* males is compared with that of the control males (text-fig. 1), that there is a retarded growth rate in the thyroidectomised birds over most of the period during which observations were recorded. Both experimental and control birds give a characteristic and similar curve. There is a rapid increase in

\* The term "thyroidectomised" relates only to the operation attempted; see results of post-mortem examination, pp. 322-25.

the rate of growth in the early part of the curve, followed by a lessening of the rate about fourteen weeks after hatching, until growth ceases at twenty-four weeks in the controls and twenty-six weeks in the experimental birds. After a stationary period the curve again assumes an upward trend.

In the case of the control females (text-fig. 2) there is a rapid growth rate up to about the fourteenth week. This is followed by a period of retarded growth extending to the twenty-second week, subsequently an acceleration in the rate occurs which is sustained until the end of the period



TEXT-FIG. 1.

of observation. Similar curves are obtained for the partially ovariectomised and partially thyroidectomised females. There is, again, a suggestion of a resting period followed by an acceleration in growth rate.

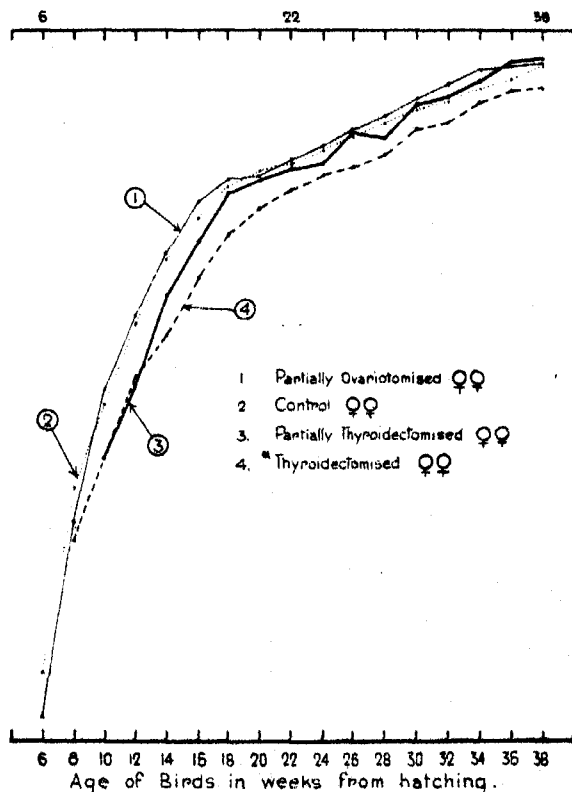
Such a pause in growth has been described previously for the fowl by Latimer, who regards it of somewhat doubtful significance. Certainly, from the time of its appearance, both in males and females, it is apparently not related in any way to the sexual activities of the animal.

Deductions may be made from the curves as to the effect of the operations on the growth rate. A depressed growth rate ensues following the operation—the duration of the depression depending on the completeness of the thyroid removal and not on the severity of the surgical interference. Recovery from the operation is more prolonged when complete thyroid-



ectomy is attempted. The males show the effect more markedly than the females, but, as will be seen by reference to the section dealing with the plumage changes, they showed the effect of the operation right up to the time of death, whereas the effect of the operation on the plumage of the females was only transient.

No definite conclusions may be drawn from these observations on



TEXT-FIG. 2.

weight and growth in the operated birds since the numbers are too small; but tentatively it can be stated that there is a definite depression of the growth rate following thyroidectomy, the duration of the depression depending on the completeness of the operation.

*Effect of the Operation on Sexual Maturity.*—The age of attainment of sexual maturity in the female is taken as the age in days of the bird from the date of hatching until laying of the first egg. For the ten thyroidectomised females which reached maturity this was found to average 240 days, the range of variation of the individual birds being from 223 to 268 days.

The average age of maturity in eighteen control females was found to be 258 days, with a range of individual variation of from 217 to 304 days. In twenty-one birds that had been partially ovariectomised soon after hatching, the average age on attainment of sexual maturity was found to be the same as in the control birds.

We are indebted to Mr J. Fraser Roberts for the statistical treatment of the data shown in Table III.

TABLE III.

	No. of Birds.	Mean in Days.	Standard Error.
Controls . . . . .	18	257.8	± 4.788
Ovariectomised . . . . .	18	267.9	± 4.712
Thyroidectomised . . . . .	10	240.5	± 5.686

Difference: Controls—Ovariectomised	= 0.1 days $\pm 6.718$ i.e. insignificant.
Controls—Thyroidectomised	= 17.3 „ $\pm 7.434$ „ 2.33 times standard error.
Ovariectomised Thyroidectomised	= 17.4 „ $\pm 7.385$ „ 2.36 times standard error.

From these data it will be seen that thyroidectomy does not adversely affect the onset of sexual maturity in the female.

The appearance of an increased vascularity in the head furnishings, accompanied by heterogonic growth in the comb and wattles, can be taken as an indication of sexual maturity in the male. Unfortunately, however, no observations of the initial appearance of these signs of testis activity were made in the operated males.

*Effect of the Operation on Weight of Eggs.*—It was found that a sample of 137 eggs laid by the thyroidectomised birds yielded an average egg weight of 50.7 grms. The average weight of an egg from control females derived from a measurement of the weight of 167 eggs was 49.3 grms. The operation had no effect on the weight of eggs produced.

*Effect of the Operation on Fertility.*—One hundred and three eggs laid by thyroidectomised hens were tested for fertility. The eggs were incubated for ten days and then examined. Of the total number opened on the tenth day of incubation, 14 of the eggs were fertile, but the embryos had died some time previous to the examination, 74 of the eggs contained living embryos, and 15 proved unfertile. These figures compare favourably with those obtained from fertility records of control birds. No evidence of the production of a disturbed sex-ratio due to interference with the thyroid glands of the parent birds was obtained from the limited number of embryos examined. Of the 74 embryos

alive at the tenth day of incubation there were 34 males and 35 females—the remaining 5 embryos were not sexed. Since the thyroidectomised females were mated with the thyroidectomised males, there is no evidence of infertility on the part of the males.

#### *Case Histories.*

Before proceeding to an analysis of the plumage changes produced as a result of the operation, it will be necessary, first, to outline the results of the post-mortem examinations on the operated birds to determine in how far our attempts at complete removal of the thyroid gland had been successful. It was found that in only two cases had complete removal of both thyroid lobes been performed.

No. 76 ♀.—From the time of operation this bird showed symptoms of general ill-health and was confined to hospital for special treatment. It was kept in hospital for six weeks, by which time it had apparently recovered sufficiently to enable it to be removed to the pen with the other operated birds. Soon after its removal the bird collapsed, but recovered rapidly when brought into a warm room. It was kept in a large cabinet artificially warmed, and while in such surroundings ate well, exhibited normal activity, and showed no tendency to collapse. However, death suddenly ensued fifty-four days after the operation. Examination of the bird post-mortem showed that the organs were apparently healthy. There were large accumulations of fat covering the viscera and in the region of the neck. Examination of the operated region on both right and left sides revealed complete absence of thyroid tissue. This was confirmed by an histological study of the tissues at the operation site.

No. 116 ♂.—Recovery from the operation was uneventful, but six weeks later, on exhibiting symptoms of ill-health, was removed to hospital. Again, as in the case of No. 76, the bird responded to an increased temperature and rapidly recovered. When transferred to the outside pen again it collapsed, and only prompt removal to warmer surroundings brought about its recovery. From now on it was kept in the heated cabinet with No. 76. The bird died suddenly seventy-three days after the operation.

Right up to the time of death the bird ate well and was as active in its movements as the control birds. When examined post-mortem an increased deposition of fat in the region of the neck and covering the viscera was noted. The organs were apparently healthy. Macroscopical examination of the site of the operation showed that both thyroid lobes

had been successfully removed. This was confirmed by an histological examination of the tissues from this region.

Both these birds showed what can only be regarded as typical symptoms of extreme thyroid deficiency. Perhaps the most striking of these was the very marked retardation of growth. At seventeen weeks No. 76 weighed but 540 grams as compared with 1000 grams representing the average weight of the control females of the same age. In No. 116 the growth was retarded to an even greater extent. At sixteen weeks the weight of the bird was 340 grams, while castrated males of the same age had an average weight of 1330 grams. (Since these birds died at a comparatively early age they are not included in the section previously devoted to growth in the operated birds.) It should be noted also that the remarks applied to the birds in that section referred to as completely thyroidectomised are not strictly accurate, since with the two exceptions cited above all contained at least some regenerated thyroid tissue.

In thyroidectomised animals the body temperature is lower than normal, and the fact that these birds showed signs of collapse when removed to an outside pen, but recovered rapidly when brought into a warmer atmosphere, indicated that this characteristic symptom of extreme thyroid deficiency in other forms is likewise exhibited by the completely thyroidectomised fowl. Adiposity, another general indication of thyroid deficiency, was exhibited by both these birds. The deposition of fat occurred principally in the neck region and the visceral coverings.

A marked retardation in the rate of feathering was noted in both these birds. This might have been expected, in view of the fact that growth of the body as a whole was so depressed following the operation. In the remaining birds of the series such a retarded rate of feathering was not a concomitant even in cases of almost complete thyroid removal.

The remainder of the operated birds may be grouped in the following classes according to the completeness of the operation:—

*Class A.*—Those birds in which complete thyroidectomy had been attempted but only one of the lobes had been successfully removed:

(1) No. 169 ♂.—Right thyroid completely removed. Thyroid tissue present on the left side. This bird, because of its interest with regard to its plumage has been kept alive. An exploratory operation to determine whether the thyroid had been completely removed was performed forty-three weeks after the initial operation. This is the only one of the incompletely thyroidectomised birds which shows in its bodily characters marked symptoms of hypothyroidism. As in the case of Nos. 76 and 116

there was a very marked retardation of growth. No. 169 at thirty-eight weeks weighed only 1390 grams as compared with 2070 grams, the average weight of five castrated males of the same age. The skeletal defects characteristic of the extreme conditions of hypothyroidism in other forms are well shown in this bird. The bird has extremely short legs, and in consequence has the appearance of a dwarf. Perhaps the most well-marked deviation from the normal is exhibited by the spurs. In the normal castrated male these are long, strong, and pointed, whereas in No. 169 the spurs are comparatively short, soft, and blunt.

(2) No. 37 ♂.—Right thyroid completely removed. Thyroid tissue present on the left side.

(3) No. 35 ♀.—Left thyroid completely removed. Thyroid tissue present on the right side.

*Class B.*—Those birds in which complete thyroidectomy had been attempted but neither gland had been completely removed:

(1) No. 33 ♀; (2) No. 57 ♂; (3) No. 34 ♀; (4) No. 72 ♀; (5) No. 81 ♂;  
(6) No. 60 ♂; (7) No. 86 ♀; (8) No. 99 ♂; (9) No. 106 ♀; (10) No. 115 ♀.

*Class C.*—Those birds in which removal of one lobe of the thyroid was successfully attempted:

(1) No. 11 ♀.—Left thyroid completely removed.

(2) No. 30 ♀.— " " " "

(3) No. 27 ♂.— " " " "

*Class D.*—One bird in which the complete removal of one lobe of the thyroid was unsuccessfully attempted:

(1) No. 15 ♀.

The amounts of the thyroid tissue present in operated and control birds is shown in Table IV.

TABLE

Number and Sex of Birds . . .	169♂	34♀	81♂	60♂	106♀	72♀	115♀	11♀	...	...
Weight of Thyroid in Grams— Operated Birds . . .	...	·03	·015	·03	·042	·055	·065	·09	...	...
Weight of Thyroid in Grams— Control Birds . . .	...	...	...	...	...	...	...	·09	·11	·11
Number and Sex of Birds . . .	...	...	...	...	...	...	...	89♀	7♀	112♀

Unfortunately the thyroid tissue from Nos. 33, 86, and 99 was not weighed on removal and therefore could not be included in the table. No. 57 died in hospital nine weeks after the operation from an extensive

infection of a wound in the leg. Thyroid weights from this bird are not comparable owing to the difference in age and are therefore not included.

All the birds were killed at periods varying from 31-59 weeks subsequent to the operation when they were in good health. The thyroid lobes were removed and extraneous tissue as far as possible separated from them. The thyroids were weighed and then fixed for subsequent histological examination.

*Thyroid Regeneration.*—From Table IV it will be seen that there is a considerable range of variation in the weights of thyroid tissue from the controls. In the operated birds the amount of thyroid tissue present shows a much greater range of variation, approximately 50 per cent. of the birds possessing an amount of thyroid tissue well below the lowest weight obtained for a control bird, while the other 50 per cent. have an amount of thyroid within the range of variation of weights from control birds.

All birds from which complete removal of the thyroid gland was not attempted, viz. Nos. 11, 15, 30, and 27, possessed at the time of post-mortem examination an amount of thyroid tissue equivalent to that of the control birds. The remaining birds, i.e. those in which complete thyroidectomy had been attempted, possessed varying amounts of thyroid tissue, the majority having much less than is normally present in control birds, but two of the birds, 35 and 37, contained a relatively normal amount of thyroid tissue.

*Histology.*—For histological examination the thyroid tissue was fixed in Bouin's fluid and the sections stained with Heidenhain's hæmatoxylin and eosin. When compared with the normal thyroid, several of these regenerated fragments revealed interesting features.

In the first place, the actual weight of the tissue, as given in Table IV, IV.

...	...	37♂	...	...	...	15♀	30♀	...	...	...	...	...	35♀	...	27♂
...	...	12	...	...	...	14	15	...	...	...	...	...	22	...	285
11	115	12	125	13	135	...	15	15	165	165	17	175	...	225	...
142♂	104♀	161♀	23♀	43♀	20♀	...	12♂	152♂	32♀	103♀	108♂	40♀	...	383♂	...

does not represent in all cases the actual weight of thyroid tissue, since in a number of cases pieces of parathyroid and thymus tissue had been included.

The most striking deviation from the normal structure of the gland is shown by the thyroid tissue from No. 35 (Pl. I, figs. 1 and 2). The regenerated thyroid from this bird consisted largely of a cyst lined by epithelium and encapsuled by fibrous tissue. The typical thyroid tissue was restricted to a narrow band internal to the fibrous walls. The nature of the fluid in the cyst could not be determined as the cyst had collapsed on fixation. There was, however, no trace of normal colloid in the cavity shown in the sections. Several large vesicles were present, each of these being many times larger than the largest vesicles observed in the thyroids from the controls. They were filled with a faintly staining colloid substance and their secretory epithelium lining was much flattened. The remaining thyroid tissue present consisted of a few medium-sized, apparently normal thyroid vesicles and a large number of very small ones lined with columnar epithelium. Colloid could be demonstrated in many of these small vesicles, but in others none was found.

The right thyroid from No. 33 and the right thyroid from No. 106 showed a similar formation of a thick-walled cyst lined by a narrow band of thyroid tissue.

The most degenerate thyroid structure was exhibited by the left regenerated fragment of No. 60. Only a few vesicles were present; these were very large and irregular in outline, and in only one or two was there any trace of the secreting epithelium. All the other vesicles lacked the epithelial lining. In none of the vesicles was any typical colloid seen. The lumen was filled with a scanty pale substance in which globules of a colloid-like substance and cell debris, formed by the degeneration of the desquamated epithelial elements, were suspended. The intervesicular spaces were heavily infiltrated with lymphocytes.

In contrast to the two types of histological appearance outlined above, the other fragments examined showed much less deviation from the normal structure. This was concerned mainly with the size and shape of the vesicles, many of which were larger and more irregular than those present in the thyroid glands of control birds. "Piling" of the epithelium cells occurred. Numbers of these elements were also found lying free in the colloid. A marked tendency of the vesicles to coalesce (Pl. I, fig. 3) to form cysts of various sizes was noted, which reached a maximum development in the cases previously described.

All the thyroid fragments contain what appears to be an area of active proliferation of new thyroid follicles, which tends to be localised at the periphery of the gland (Pl. I, fig. 4). The follicles present in such groups are small, some consisting of a solid mass of cells, while others

possess a central lumen in which colloid is present. The constituent cells of the small follicles show evidence of mitotic activity. Such an activity is also exhibited by the epithelium of the larger vesicles, but is restricted to that portion lying immediately below the fibrous capsule. Few, however, of the larger vesicles reach the periphery of the organ, since the general arrangement is such that these tend to occur centrally, the size of the vesicles gradually decreasing from this region outwards. This distribution of the vesicles in point of magnitude is the reverse to that present in the developing thyroid of man (Cooper).

The appearance of numbers of small follicles suggests the possibility that a formation of new thyroid vesicles is occurring. Such a conclusion, however, would be contrary to the theory advanced by Uhlenhuth, Wilson, and others, that the number of follicles is determined at an early stage in development and their growth is in size and not in number.

*Effect of the Operation on Plumage.*—The distribution of the feathers into well-defined areas according to their structure and colour is a marked feature of the Brown Leghorn. The observations on the plumage of the operated and control birds did not extend to an analysis of the feathering in all such regions of the body, but has been confined to those which show an extreme dimorphism in the two sexes. To this end only the areas referred to as the cape, the breast, the saddle, and the wing bow and coverts\* were specifically dealt with.

In order to obtain data on the extent of the changes produced by the operation, it was necessary that observations should be made on successive feather generations from the same follicles. At the time of operation, then, in each of the above noted regions, an area of the skin was denuded of feathers and the extent of such pluckings outlined by tattooing with Indian ink. As soon as the new feathers in the marked areas grew in and reached maturity they were removed. By this means a sequence of feathers from the same follicles was obtained from the time of the operation up to the time the birds were killed. For the examination of the plumage of the control birds the same method was adopted.

Ridgway's *Nomenclature of Color* was used as a standard for the classification of the types of colouring occurring in the feathers, but in order to avoid the frequent repetition of his more explicit and therefore more cumbersome terms, the less specific designations in common use have been employed, and where these differ from Ridgway's standards,

\* The nomenclature used is that given in the *American Standard of Perfection*.



the latter have been appended to the former at their first occurrence in the text.

*Control Birds.*—If we consider first the feathers from the plucked areas of the male. In the chick at five weeks old the body is fairly well covered in some regions by the first definitive feathers. On the *breast* these are small and rounded with no perceptible peripheral fringing. The shape index (*i.e.* the ratio of length of feather to breadth) is roughly 3 to 2. The colour is a groundwork of salmon (Ridgway: vinaceous buff) with black mottling in the distal two-thirds; proximally the feathers are slate coloured and fluffy. At ten weeks the new breast feathers are much larger than the previous generation and the shape index is now 2.5 to 1. There is a slight indication of fringing round the distal end of the feathers. The colour is now solid black, with no coloured mottling except a faint suggestion of salmon at the extreme tip. In the adult the breast feathers are a solid black and have a shape index of 3 to 1; otherwise they are similar to those of the ten-weeks' chick.

In the *cape* region at five weeks the feathers are a slaty black, with a cream-coloured median line which includes the rachis and a narrow strip of the feather blade on either side of it. Round the edge there is some pencilling of a similar hue, and a restriction in the number of barbules gives a suggestion of fringing. The feathers are somewhat broad and flattened at the apex with a shape index of 2.5 to 1. At ten weeks the feathers are a solid black with a small red (Ridgway: liver brown) or mottled red apical portion which tends to stretch down the rachis a short distance. The end of the feather is now broad and rounded with a short apical fringe. In the adult male the cape feathers have a rounded apex and a shape index of 2.5 to 1. They have, however, an illusionary appearance of being sharply pointed, partly due to their deep apical fringing, and partly because the barbed portion of the feather ends in a point shaped like an arrow head, with its apex, distally directed, lying along the rachis. The proximal two-thirds of the feathers are solid black and the rest a rich red. The black pigment does not extend out as far as the limit of the barbules, but terminates parallel to it, thus forming a second "arrow head."

The *wing-bow* feathers at five weeks are drab coloured with black pencillings and a light-coloured rachis. In the newer feathers the drab has been replaced by red. There is no definite fringing of the feathers: they possess a rounded apex and have a shape index of 3 to 1. At ten weeks the feathers are a solid black with large irregular red splashes which sometimes take the form of a distinct bar across the feather.

There is a tendency for the red pigment to extend along the rachis. The feathers are still unfringed and are blunt and somewhat flattened at the apex. The shape index is still 3 to 1, but the feathers are much larger than in the previous generation. In the mature bird the wing-bow feather is similar in structure, colour, and colour pattern to the adult cape feathers, with the exception that the black pigment is restricted almost completely to the fluffy base of the feather. In shape the feather is much shorter and proportionally broader. (Shape index, 2.5 to 1.)

At five weeks the wing coverts are similar in colouring to the wing-bow feathers, but twice as long. At ten weeks they are a solid glossy black and their shape index is 4 to 1. The adult feathers are similar in structure and colour to those of the ten-weeks' chick.

The *saddle* feathers at five weeks are a slaty black with pencillings of drab colour. The tip is blunt and flattened; the distal portions of the barbs are free and form a rough fringe, giving the feathers a loose, fluffy appearance. At ten weeks new feathers are red with varying amounts of indeterminate black ticking, the latter, when present in greater amounts, gives the feather a grey-brown appearance. The shape is slightly longer and there is now a more definite apical fringe. The adult feathers are lanceolate, long, and narrow, with a slightly wider base, and a shape index of 5 to 1. They are deeply fringed right down to the top of their downy region and are of a golden-red colour (Ridgway: tawny).

The feather pluckings from control females were taken slightly later than those from control males. The female *breast* feathers at seven weeks are similar in size and structure to that of a five-weeks' male, and the colour is practically the same—salmon with black mottling. At twelve weeks the feathers are salmon coloured, and some have a trace of black pigment at the apex which is rounded and unfringed; the base is fluffy and slate coloured and the shape index is 2 to 1. In the adult bird they are slightly longer (shape index, 3 to 1), the fluffy base takes up, roughly, one-third of the feather, and only a faint grey mottling can be seen on some of them.

The *cape* feathers at seven weeks are the same shape as those from the first plucking in the male. (Shape index, 2 to 1.) The colour pattern is formed by alternating pencillings of black and drab colour which become more intense towards the apex. The rachis is cream coloured. At twelve weeks (Pl. II, fig. 5) the feather is slightly more rounded at the top than in the male and has a suggestion of apical fringing. The colour is the same as at seven weeks, except that the

cream colour of the rachis has extended slightly into the feather blade on either side, making a more pronounced bright median line. Proximally the feather is fluffy and slate coloured. The adult cape feather does not differ materially from this type, except that the shape index is 3 to 1 as compared to 2 to 1.

At eight weeks the *back feathers* (which correspond to the male saddle hackle) have a shape index of 2 to 1. The downy basal part takes up two-thirds of the length of the feather; the distal end is rather broad. The colour is similar to the cape feathers of the same age, except that the rachis is dark. At twelve weeks they are longer, and now have a shape index of 3 to 1, half of the feather being downy. Distally the feather again resembles the cape feathers but the pencilling is closer than in the latter.

Wing-covert feathers at eight weeks have a shape index of about 3 to 1. There is practically no downy part. On the outer side of the rachis the feather blade is pencilled with drab and black colour, while on the inner side it is black with only a little drab stippling near the apex. Later generations of feathers from this area only differ from this plucking in that they are progressively larger and longer, and in the adult feather the shape index is about 4 to 1.

In the wing-bow feathers of seven weeks the basal third is slate coloured and downy and the apex is blunt and rather rounded. The blade of the feather is pencilled black and drab, but the black is less intense than in the cape feathers. In later pluckings the shape index is 3 to 1, and the central part of the feather blade takes on a faint reddish hue.

*Plumage Changes in Experimental Birds.*—The degree of plumage change following the operation of thyroidectomy varied in individual birds and appeared to be correlated to some extent with the completeness of the operation. Thus it is possible to divide the birds into the following groups:—

- (1) Those which were semi-thyroidectomised and showed practically no deviation from the normal type of plumage: ♀♀ Nos. 11, 15, 30; ♂ No. 27.
- (2) Those birds which were found on post-mortem to be incompletely thyroidectomised although complete removal of the thyroid tissue had been attempted; they were sufficiently deprived of thyroid, however, to exhibit definite plumage modification: ♀♀ Nos. 33, 34, 35, 72, 86, 106, and 115; ♂♂ Nos. 37, 57, and 81; ♂♂ Nos. 60, 99, and 169.

- (3) One female (No. 76) and one capon (No. 116) which had been completely thyroidectomised and in which the plumage was profoundly changed.

In *Class I* Nos. 11 and 15 showed a slight transient redness in the cape feathers, and one or two of these from the latter were slightly pointed. Otherwise there was no effect on the plumage of this group.

*Class II.*—New feathers are to be found growing in all over the body in chicks of this age (five to ten weeks) and in the hypothyroid birds modifications occurred in these as well as in the feathers growing in the plucked areas. The incidence of the plumage changes was first noted about three weeks subsequent to the operation: in the females reddish feathers with bright gold edges appeared here and there on the cape and forewing, and soon formed a distinct bright arc extending from edge to edge of the outstretched wings over the region corresponding to the male wing bow and passing through the cape. The first indications of feather modification in the male were seen on the breast where the amount of red pigmentation was much more extensive than is usual in the juvenile male.

By the time the feathers in the plucked areas had matured it was evident that modifications had been produced in the feathers of both males and females in nearly all regions of the body. Further, these changes, though varying in extent in the two sexes and in the different plumage areas, tended in the same direction in all cases, and concerned both the structure and the pigmentation of the feather.

*Structural Changes.*—Modified feathers on the cape, back, wing bow, wing edge, and breast in the females exhibited a border more or less heavily fringed, due to a decrease in the number of barbules which normally clothe the barbs of these feathers almost to their tips. Within the fringe the blade was pointed, causing the feather to appear reminiscent of the cape or wing-bow type in the adult male. The feathers appeared more slender than their prototypes from the control female. The extent and depth of the fringing varied in individual birds as well as in the different areas on the same bird; the wing bow and saddle tended to be more heavily fringed than the cape; the breast was the least affected of all marked areas, and although fringing of the breast feathers occurred in all the females, it was only in two (Nos. 34 and 35) that the imitation of the male type of feather structure could be clearly seen in this region (Pl. II, fig. 14).

In the males—both complete and castrated—the modification took the form of a tendency to increased fringing of the feathers. In the

cape and wing bow this led to the premature appearance of the adult male type of feather structure. In the saddle, the feathers, though elongated, were neither so heavily fringed nor so finely pointed as in the mature individual. The wing-edge feathers, which in the adult have little or no fringe, showed a structure similar to that of the modified cape feathers. In the three males of this group which showed the most effect (Nos. 81, 99, 169) the neck hackles appeared very ragged, due to the unusually deep and irregular fringing of their component feathers. The breast feathers also showed a decrease in barbule formation, but it was never sufficient to give a clean-cut fringe as was the case in some of the females.

In both sexes the fringing was exhibited both in feathers that were partly grown at the time of the operation and in the new feathers that grew in subsequent to it. In the former case the distal part was of the normal juvenile structure and the fringing appeared lower down, giving the appearance of a sudden narrowing or "necking" of the feather at the onset of the effect (Pl. II, figs. 7 and 10).

*Colour modification* of the feathers was simpler in the males of this class than in the females. In the red and black feathers of their cape, saddle, and wing bow the amount of black pigment was decreased and there was a corresponding increase in the amount of red. The latter also appeared in the feathers of the wing edge, breast, and thigh, all of which under normal circumstances are solid black. In those birds least affected the only colour abnormality on back and wing was in the saddle area where the feathers were unusually red for a juvenile male; in those most affected, however (Nos. 81, 99, and 169), the cape, saddle, wing bow, and wing edge were almost wholly red and showed only a few traces of melanin instead of being mainly black as is typical of this age. Breast feathers were modified in varying degrees: in No. 99 they were almost completely salmon with only a small black tip or a few sparse traces of melanin; in Nos. 81 and 169 they were sharply demarcated into a distal and a proximal half, the one being salmon and the other black. Again, in a capon (No. 60) the red colour appeared as broad transverse bands on a black ground, giving a barred appearance. In the remaining birds the breast feathers only differed from those of the controls in that they had more salmon mottling than was typical at this age.

In the females the breast feathers showed no significant deviation from the normal colouring, although in Nos. 34 and 35 the structurally modified feathers seemed to be a slightly deeper tone of red; but on the back and wing, feathers appeared in which the black and drab pencillings were

replaced by sparse black stippling on a ground of red. In Nos. 34, 35, and 86 (Pl. II, figs. 6, 7, 10, 11) this change was well marked, and in some feathers only a few flecks of melanin remained. In Nos. 106 and 115, on the other hand, it was still possible in most feathers to trace the line of the melanic pencillings, but they were broken and irregular and disappeared altogether in the fringed edges of the feather. When a feather exhibited fringing at the tip the fringe was usually a pale gold colour, but when the fringing occurred farther down the vane, the whole of the modified region was usually of a darker hue.

Although in the main the colour change in the females could not be described as a change towards maleness, yet the fact that the melanin tended to be aggregated in a rough triangle above the downy base in some of the more modified of the back and wing feathers, caused the more pointed ones to have a distinct resemblance to male feathers. Again, the substitution of red in the outer web of the secondaries in some individuals was such that they exhibited a bright wing bay area like that of the male.

While Nos. 33 and 72, which were partially ovariectomised as well as thyroidectomised, showed, on the whole, similar changes to those exhibited by the other birds in the group, it has been thought advisable to overlook the slight difference in plumage changes which occurred in those (such as the brighter gloss on the feather), since it is impossible to tell in how far their feather modifications are to be attributed to the former operation and how far to the latter.

The changes in feather colour and structure exhibited by the females of this group, subsequent to the operation, were of short duration, and had practically disappeared after two pluckings. In the males, however, there seemed a tendency for the abnormal feathering to persist. In No. 81 at the time of autopsy (37 weeks) the saddle feathers were still abnormally red and fringed, while the breast feathers exhibited large amounts of red pigmentation in solid areas which took up the whole width of the feather blade and sometimes extended to include it, all except for a small black tip and the slaty, downy region at the base. The former melanic area followed the line of the feather barbs in such a manner that it appeared as a black spangle on a red feather. In shape, these feathers were abnormally long and narrow. In No. 60 at autopsy (39 weeks) similarly modified breast feathers occurred, but it is of interest to note that in both these birds the previous generation of breast feathers had been black and unfringed as in the normal. In No. 169, which is still alive, the plumage has remained continuously abnormal. The breast (Pl. III, figs. 22, 24) and saddle feathers in the full-grown bird show the same abnormalities as did those in

the adult plumage of No. 81. But other areas also remained clearly affected: in the cape and wing bow the feathers were deeply fringed and red right down to the edge of the basal, downy portion; the wing-edge feathers remained red and fringed, and even the coverts, which normally are a glossy black in the adult, showed large areas of red. The red colouration of the saddle and wing bow was somewhat darker than in the controls; the neck hackle was loose and also of a dull red colour.

*Class III.*—Feather growth seemed somewhat slower in these two birds than in the controls, or in the birds described above. By the time of their death, however, it could be seen that marked changes were occurring in their feathers (Pl. II, figs. 8, 12, 15). In the female, the most modified breast feathers showed a complete absence of barbules in the feather blade. The pigmentation was the same as in the normal female, but the salmon colour tended to extend into the downy part so that the lateral ends of the down barbs are salmon, but nearer the rachis they become slate coloured again. Saddle and cape feathers in the most extreme cases consisted almost entirely of red fringing, the barbs having only a few barbules close to the rachis; others slightly less modified exhibited a "male-like" structure. Broken melanic bands ran across the red ground colour of the blade near the base; in some, the red again penetrated into the downy region. The latter part was greatly decreased in size in the new full-grown feathers in these areas as was also the case in the breast; in the most extremely modified feathers it practically disappeared. The wing contour feathers from the regions which correspond to the wing front and wing bow in the male showed similar modifications. The coverts were abnormal in their proximal half, in that they had a red rachis, and in place of the usual black and drab pencilling on their outer web in the female (or black in the male) they had red with a sparse black stippling. These feathers had a ragged edge proximally which might be interpreted as a tendency to fringing; however, the barbules were not absent, though it is possible that the hooklets were. The secondaries showed no sign of fringing, but their outer webs were bright red with only a trace of black stippling, and were thus very similar to those of the male.

In the male (No. 116) the new feathers growing in after the operation were exactly similar to those of No. 76 described above.

It will be seen then that, broadly speaking, the effect of hypothyroidism shown in the feathers of both male and female is an increase in the depth of fringing, i.e. a decrease in the amount of barbule formation and an increase in the extent of the red pigment at the expense of the black. The extreme form of this is seen in the completely

thyroidectomised male and female, where new feathers growing in on all regions of the body were red. Also all these feathers, with the exception of the flight feathers of the wing and the tail feathers, were almost completely devoid of barbules. In the incompletely thyroidectomised female the feather changes were of short duration, whereas, in the male, such modifications as were produced tended to persist throughout the whole time the birds were under observation. This may be correlated with the completeness of the operation.

#### PART II.—THYROID FEEDING.

Before entering into an extended discussion on the bearing of the thyroid gland on the sexual characterisation of the plumage in the Brown Leghorn, it will be necessary to review briefly the previous work relating to the effect of hyperthyroidism on the plumage of this breed and also to give the results of our own investigations in this field.

Cole and Reid (1924), fed four adult males with desiccated thyroid gland over a period of twelve weeks. They each received 400 mgms. of the dried substance on alternate days for a period of three weeks, after which they were subjected to the same dose daily until the end of the experiment. The new feathers growing under the influence of the thyroid medication, while not typically female in type, showed distinct female characteristics. "As relates to colour, there was an evident action toward the reduction of red pigment, varying in degree in the different birds but tending to be arranged in 'stippling' when present. This was particularly true in the new cape feathers of bird No. 441, which were decidedly female-like in appearance. The resemblance to female feathers was much more striking in respect to shape and structure."

Horning and Torrey (1927), from observations on thyroid-fed Brown Leghorns, found that those feathers in the male characterised by a lacy border of naked barbs tended to clothe themselves to their tips with extensions of the normal two rows of barbules. The melanin pigment extended also to the edge of the feather, for as a rule this pigment is carried by the barbules and is limited by their distribution. The same results were obtained from thyroid-fed capons, with the exception that they did not become more deeply pigmented with melanins. The plumage of the females darkened under the influence of thyroid feeding, but not to the same degree as in males of the same age, and apparently not at all in birds in their first year.



Zawadovsky and Rochlin (1928) also found that feeding small doses of thyroid to Brown Leghorns led to an increase in the black pigmentation in the feathers. While in the cock and young hen the hackle feathers assumed a more or less equal amount of black pigmentation, in the growing hen a new distribution of black pigment in horizontal stripes occurred. They conclude from a detailed study of the modified feathers that it is not possible to describe the changes in the character of the feathers as in any way approaching a metamorphosis of the male feathers to the female type or *vice versa*.

A small subsidiary experiment was carried out by the present authors. In this desiccated thyroid gland was administered to four normal Brown Leghorn fowls (two males and two females) and one thyroidectomised capon, No. 169 referred to in the previous section. The birds were from the same stock as those used in the experiments of thyroid removal, and with the exception of No. 169 were hatched in 1928. The two males, Nos. 430 and 474, were hatched on the 21st March, while of the two females, No. 475 was hatched on the 21st March and No. 888 on the 24th May.

*A. Details of Thyroid Feeding to Normal Males and Females.*

Thyroid feeding was commenced on the 23rd October, when three of the birds were 31 weeks old and the fourth 22 weeks. (The preparation of thyroid gland used was Armour's Desiccated Thyroid Powder.) All the birds were given the same amount of dried thyroid at the beginning of the experiment, namely, daily doses of 0.25 gram. As the birds differed considerably in weight at the beginning of the experiment, the amount of the dried substance administered per 1000 grams body-weight is given below. In order that the dosage may be compared with that employed by the other workers referred to previously, the amounts which they administered have been calculated on the same basis and included in Table V.

The birds were given thyroid daily up to the 14th December with the exception of No. 474. It was thought necessary owing to the ill-health of this bird to discontinue the experiment, and thyroid feeding was stopped on the 1st December. It was not considered that the thyroid feeding was directly responsible for the condition of the bird, since the cessation of the thyroid administration did not result in any appreciable improvement in health.

From the 14th of December up till the 24th of December the dose was doubled in the case of the two females. This was further increased

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to 1 gram of dried substance from the 24th to the 28th of December inclusive, when the experiment was discontinued. No. 430 received no

TABLE V.—DOSE OF THYROID PER 1000 GRMS. OF BODY-WEIGHT.

No. 430 ♂	135 mgrms. daily for	9½ weeks.	♂ ♀ 200 mgrms. Daily over extended period.
No. 474 ♂	110   "   "   "	5½   "	(Horning & Torrey.)
			♂ 200   "   Alternate days for 3 weeks.
			Daily for 9 weeks. (Cole and Reid.)
No. 475 ♀	180   "   "   "	7½   "	♂ 150   "   Average daily dose for 16 weeks.
	360   "   "   "	10 days.	♀ 170   "   Average daily dose for 11 weeks.
	720   "   "   "	5   "	♀ 310   "   Average daily dose for 8 weeks. (Zawadovsky and Rochlin.)
No. 888 ♀	205   "   "   "	7½ weeks.	
	410   "   "   "	10 days.	
	820   "   "   "	5   "	

increase in the amount of dried substance fed—i.e. he received 0.25 gram from the beginning of the experiment until the end.

*Effect of the Experiment on General Health.*—The birds remained healthy, with the exception of No. 474, throughout the course of the experiment. Apart from the youngest, No. 888, there was practically no increase in the weight of the birds, although soon after the end of the experiment the growth-rate was accelerated again. Although No. 888 showed progressive increases in weight, the amount was considerably below that of control birds of the same age. No. 475 was in full lay just previous to the experiment. The effect of thyroid feeding resulted in a cessation of egg-laying, the comb became pale and regressed considerably in size. Soon after the thyroid feeding had ceased the comb became red again, increased in size, and the bird commenced laying three weeks later.

Of the other three birds, ♂ No. 430 showed a rate of comb-growth which was not affected by the treatment. The comb of ♂ No. 474 rapidly diminished in volume, this resulting from the ill-health of the bird, which probably did not have its origin in the thyroid feeding. No. 888 showed no signs of comb-growth before or during the experiment.

*Plumage Changes.*—Changes in feather structure and colour were first noted in one male and one female (Nos. 474 and 888) in the new feathers which were growing in the neck hackle eighteen days after the first dose had been fed. Ten days later a definite effect could be seen in the areas which had been denuded of feathers and marked in the manner described in the earlier series of experiments.

In the males (Pl. III, figs. 18-20) thyroid feeding caused an increase of melanin in the feathers at the expense of the red pigment in all areas where the latter is present. There was a tendency for the fringed feathers to have barbules right to the outer extremity of the barbs and the feathers thus tended to be "solid." Rounding of the apex of the feathers occurred approximating them to the female type. As the black encroached on the red in the feather it might be broken into splashes (as in the cape and hackles), or be diffused throughout the feather (as is sometimes seen in the saddle), but it never showed any definite tendency to follow the female pattern of pigment distribution. The breast feathers remain black and unaltered in structure. There was a differential response to the thyroid feeding by the several differentiated feather regions. It was found that the maximum effect both with regard to colour and structure was exhibited by the feathers of the wing bow, while those of the cape appeared to be affected to a greater degree than those of the saddle.

Thyroid feeding to females (Pl. III, figs. 16, 17, 21) had a much less obvious effect on the plumage than was the case in the males. In the back, cape, and wing of the female the feather shape and structure remained unaltered, but their light-coloured pencillings became colder and darker as if the melanin had increased in amount, and a slight reddish tinge which had been present in previous generations had disappeared. The feathers of the neck hackle showed a decrease in the extent of the fringe, increased melanin deposition, and rounding at the apex. In the breast feathers the salmon colour faded to a dull, faintly greyish white.

There was an indication in the wing contour feathers of the females that thyroid feeding depresses the functioning of the birds' own thyroids, and thus led at the close of the experiment to the development of colour changes in these feathers which, from the results obtained in Part I, are indicative of hypothyroidism.

The results obtained agree in general with those of other workers. We are not able to confirm the opinion of Cole and Reid, however, that such changes in the male were suggestive of the pigment distribution found in the normal female. Further, our results in respect to females are not in agreement with those of Horning and Torrey, who found that thyroid feeding to hens in their first year was not productive of any change in the amount of melanism. But in this case the conditions of experiment differ somewhat from our own, since these authors carried on the administration of thyroid over a much longer period, and did not denude areas of feathers in order to observe the plumage modifications, but waited until the birds moulted naturally.

*B. Thyroid Feeding to Thyroidectomised Capon No. 169.*

Since this bird had shown over a period of eighteen months marked deviations from the normal colouring of the Brown Leghorn male in its plumage, it was thought desirable to determine in just how far this resulted from a condition of hypothyroidism. To this end feeding with Armour's desiccated thyroid gland powder was commenced on the 15th September 1928. The substance was administered daily, the dosage being 0.5 gram and continued for thirty-four days. This dose was equivalent to 300 mgrms. per 1000 grams of body-weight. Areas of skin on particular regions of the body were plucked and marked just previous to the initial dose. The general health of the bird remained good during the experiment.

*Description of Plumage Changes.*—The lack of black in the blade of the cape and hackle feathers, and the appearance of large amounts of red pigment in the breast and covert feathers were the most striking deviations from the normal at the inception of thyroid feeding.

First indications of an effect of thyroid feeding were noted in the neck hackle on the 2nd October. The hackle feathers changed from red to pale gold for about the depth of a centimetre, this was followed by a narrow, solid, black central blade as in the normal male feather. Half-grown saddle feathers showed the same series of colour changes, the black forming a definite arrow-head, due to an extension of the barbules along the normally naked region of the barbs.

The feathers in the marked areas were mature and plucked on the 29th October. In the cape the feathers were solid black with no trace of the red pigment. The shape of the feathers varied considerably, some were blunt while others were pointed. In addition, in all feathers there was complete disappearance of the characteristic fringing. The second plucking took place on the 14th December and the feathers obtained varied considerably in the amount of melanin present, in some of them the proportion and distribution of red and black pigment were similar to that of the normal male, while in others the black pigment was restricted to a narrow central strip in the proximal half of the feathers. In shape and structure these feathers were practically normal again.

The saddle feathers at the first plucking after thyroid feeding had begun were short (only half the length of the normal saddle feather) with a rounded, unfringed apex. The feathers were black in the distal third, followed by a deep, irregular, transverse band of red in the central region, while the proximal third again showed concentration of melanin—splashes

of which were to be seen penetrating the band of red pigment. The distribution of red and black pigment in these feathers did not in any way resemble the pattern typical of the female feather in its distribution. On the 14th December the saddle feathers had returned to their pre-experimental condition.

On the 24th October fully grown breast feathers (Pl. III, figs. 22, 23, 24) were pure black as in the normal male. By the 14th December the feathers had reverted to their original colour, black distally and red proximally. In addition to the feathers from marked areas it was seen that similar changes in pigmentation were taking place in other regions of the body. As remarked in the previous section, such changes were very noticeable in the wing-bow region.

It is apparent, then, that the pigmentary changes in the plumage of this bird following thyroidectomy must be due to a persistent condition of hypothyroidism, since by feeding thyroid it was found possible to obtain a type of feathering typical of the normal male.

### PART III.—GENERAL DISCUSSION.

*On the Relation of Thyroid Gland and Gonad to the Development of certain Plumage Characters in the Brown Leghorn.*—It is necessary first of all to emphasise the nature of the differences of plumage character in the male and female. The distinguishing features concern both the structure and colour of the individual feather, as well as the tendency of similar feathers to be restricted to certain well-defined areas of the body. It has been shown, however, in the preceding pages that these characters did not react uniformly to the experimental conditions to which they were subjected, so that only by an analysis of the behaviour of the separate characters can the nature of the dimorphism in the plumage of male and female be satisfactorily attempted.

*Feather Structure.*—The male is distinguished by the possession of certain areas in which the terminal position of the feather barbs are lacking in barbules; these areas are the neck hackle, cape, saddle, and wing bow. However, the occurrence of fringing cannot in itself be considered as a sex-limited character, since it also occurs in the female, though less well developed and restricted to the neck hackle only. Further, in the male it cannot be regarded as a secondary sexual character, dependent for its expression on the presence of reproductive tissue, since removal of the reproductive glands does not lead to an extension or diminution of barbule formation in the feather. In the female, however,

after ovariectomy the fringe becomes longer, which suggests that depth of fringing is a female secondary sex character. The fact that such operative interference leads to an alteration in the distribution of this character will be discussed later, when the significance of regionalisation of feathers is considered.

The effect of hypothyroidism in both sexes is to increase the depth of fringing, while hyperthyroidism has the opposite effect, in that increased barbule formation is induced. Thus in the male, fringing appears to be dependent on the level of thyroid function and to be independent of the gonad, while in the female, both gonad and thyroid are involved. However, since the experimentally produced fluctuations in thyroid amount can cause a much greater variation in the expression of this character than can be produced by removal of the female gonad, it does not seem necessary to ascribe any direct action on the feather structure to the latter. Its influence would rather appear to be secondary to that of the thyroid gland, and to be correlated with it in some as yet indefinable manner.

*Feather Colour.*—With respect to colour, we have to take into consideration that, not only do the proportions of black and red pigments vary in the individual feathers in the two sexes, but their manner of distribution is also different. In the male, a range of variation is seen from a completely black feather in the breast, through increasing amounts of red pigment, to the almost complete disappearance of melanin in the feathers of the saddle. In all these cases the areas of red and black are sharply demarcated from one another. The female, on the other hand, is characterised firstly by salmon-coloured breast feathers, and, secondly, by an unequal distribution of melanin in the other contour feathers of the body, forming a definite pattern of light and black pencilling. The lighter bars are not similar in colouration to the red present in the male feather, but are of a drab colour, possibly due to a mixture of red pigment with a scanty deposition of black.

As in the case of feather structure the colour of the male feathers is unaffected by castration, while in the female removal of the sex gland is followed by the development of a plumage which has all the characteristics of the opposite sex. The feather colour and pigment distribution of the female, then, is apparently controlled by the female sex gland. Further evidence of the dependence of this colouration and pattern on the presence of the sex gland of the female is obtained from experiments on ovarian grafts in males, when following successful implantation typical female feathers are produced.

Hypothyroidism results in an extension of the red pigment at the

expense of the black in both sexes. The areas normally red tend to assume a darker tone of the same colour. The characteristic pencilling of the female disappears on account of the diminution of the black and the coincident appearance of red pigment in these regions. Hyperthyroidism in the male results in an increase in the melanin production at the expense of the red pigment. As the black encroaches on the red it may be broken into splashes, or it may be diffused throughout the feathers, but it never shows any definite tendency to follow the female pattern of pencilling. In the female an increased production of melanin is also exhibited, but to a much less marked extent. In the pencilled feathers the colour becomes darker and "colder," as if a reddish tinge had disappeared, but the pattern remains almost unaltered. The breast feathers, however, react differently to the other contour feathers in that they are not invaded by melanin as might have been expected; instead, their salmon colour becomes paler.

Hyperthyroidism and hypothyroidism in the male tend to have a directly opposite effect, and it therefore appears that in this sex the proportion of black to red pigments present is dependent on the level of thyroid functioning. In the female, however, the change is not so clear. If it were a simple change in the proportions of black and red pigment then it would have been expected that black would have appeared in the breast feathers of thyroid-fed females. Again, there is the question of the pattern of the female feathers: this does not disappear with thyroid feeding, but does with hypothyroidism. Since the female pattern is always associated with female reproductive tissue,\* and never occurs in its absence, and, further, is relatively unaffected by a condition of hyperthyroidism, then it seems reasonable to suppose that it is solely dependent for its expression on the presence of the former organ. That it does disappear in cases of hypothyroidism can be explained on the assumption that the formation of the pattern is due to a restriction (incomplete) of melanin into pencillings, for then it is seen that the female gonad would tend to limit the effect of hyperthyroidism, while in the case of hypothyroidism the two effects would be in the same direction, leading to a more complete restriction of the black, and thus to obliteration of the pattern. If this hypothesis is extended and the breast colour of the female considered as an almost complete restriction of black by the gonad, then this is in line with the observed facts as, in so far as melanin production is concerned, neither hyper- nor hypothyroidism appeared to have any effect.

\* The terms "female reproductive tissue" and "female gonad," etc., include both the ovary normally present and the resuscitated right gonad, which develops in the absence of ovary (v. Domm).

The red pigment, however, was affected by fluctuations in the degree of thyroid functioning, but whether the female gonad also plays a part in its regulation cannot be determined, since any red which may be present after ovariectomy is obviously masked by the unrestricted and intense black pigment present.

*Regionalisation of Feathers.*—In this breed the plumage is demarcated into certain well-defined areas by differences in colour and structure of their component feathers. There is, however, a sex difference in the number of these areas, of which more are present in the male. Castration has no effect on this regionalisation of the feathers, but ovariectomy leads to the development of a series analogous to that found in the male.

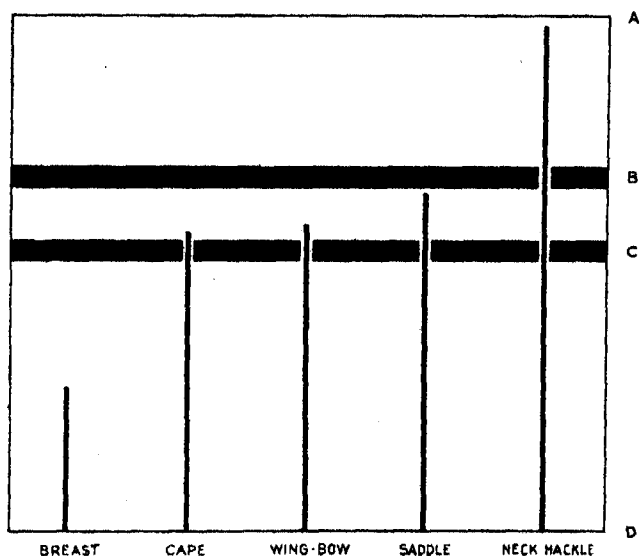
The tendency of hypothyroidism, in both sexes, is to produce feathers similar in colour and structure (red and fringed) on all regions of the body and thus to obliterate regionalisation. Hyperthyroidism likewise tended to produce in the male feathers similar in colour and structure (black and unfringed) over the whole body. From this it appears that there is a strong correlation between definite types of colour and structure (*i.e.* between black and lack of fringing on the one hand and red and fringing on the other). Hyperthyroidism in the female, however, tends to produce feathers structurally uniform in type while the colour remains practically unaffected. But on the hypothesis put forward in the previous section relating to the effect of the female gonad on colour, it is evident that this rupture in the relationship is only brought about by the intervention of the female reproductive tissue. Consideration of all these facts leads to the view that regionalisation of the feathers is directly dependent on thyroid activity, and that the degree of regionalisation is due to a differential response on the part of various areas of the body to an equal stimulation. Thus in the male the stimulus capable of producing unfringed black feathers in the breast does not induce a similar appearance in the neck hackle (text-fig. 3).

The relation between the level of thyroid functioning and the response of the feathers, in the different regions specifically dealt with, is made sufficiently clear by reference to the text-figure, in which the height of the vertical lines arbitrarily indicates the amount of thyroid activity necessary to produce a state of hyperthyroidism in the respective areas. Thus the amount of thyroid activation necessary to produce the complete change from red-fringed to black-unfringed in the breast also results in a partial transformation, differing in extent, in the other regions of the body. This is the condition in the male where regionalisation is at its maximum. Successive increases in the amount of thyroid



present cause the point of maximum response to be attained successively in different regions.

If we disregard the peculiar colour conditions present in the female, then the regionalisation shown with regard to feather structure alone is similar to that obtained in a thyroid-fed male. Our conclusions in the section devoted to colour lead to the view that but for the intervention of the gonad, colour also would have shown an effect of hyperthyroidism when compared to the normal male. Thus we are brought to the con-



TEXT-FIG. 3.—(A) Level of thyroid activity in complete hyperthyroidism—all feathers black and unfringed. (B) Level of thyroid activity in the female—only the neck hackles fringed. (C) Level of thyroid activity in the male—the breast feathers alone are black and unfringed. (D) Complete athyroidism—all feathers red and fringed.

clusion that the female thyroid functions at a higher level than does that of the male. That the greater activity of the thyroid gland in the female is dependent in some manner on the gonad and is not a primary sex difference, or not merely apparent owing to a different level of response of the feather germs in the two sexes, is clear from the results of ovariectomy.

To summarise, the plumage of the male is a reflection solely of a certain level of functioning of the thyroid gland, and its expression is independent of any influence of the sex gland. On the other hand the plumage characters possessed by the female can be considered as merely modifications of the male type of feathering brought about by two inter-

related agencies, the thyroid gland and the reproductive organ. Certain of the differences are produced by the direct effect of a raised level of thyroid functioning, such increased functioning being dependent on the presence of the gonad. Other characters result from the direct action of the gonad on the plumage and not through the intermediation of the thyroid gland.

The hypothesis elaborated above is based on that enunciated by Horning and Torrey, who from the results of their experiments in thyroid feeding were led to the conclusion that the ovary exerted a direct influence on the restriction of melanin, but did not interfere with the process of barbule formation induced by the thyroid.

Zawadovsky and Rochlin, while differing from the previously mentioned authors in their interpretation of the colour changes, agree with them in that the female gonad is antagonistic to the effects of hyperthyroidism. The conclusions of Kříženecký and Cole and Reid are in disagreement with those stated above, in that the results obtained suggest that hyperthyroidism in the male leads to the production of a type of feathering similar in colour, as well as in structure, to that of the female.

This stumbling-block to the validity of the hypothesis that female feathering owes its colouration to the presence of female productive tissue could only be avoided if it could be shown that the results obtained, though similar to our own, had led to a different and unjustifiable interpretation. Careful examination of the illustrations of Cole and Reid's paper confirms our opinion that what they refer to as "stippling" in the modified feathers cannot be considered as a true female pattern, since it consists of a fine flecking of melanin on a background of red pigment without any definite arrangement or grouping as in the typical pencilling of the female.

#### PART IV.—ON THE NATURE OF THE PLUMAGE IN THE IMMATURE FOWL.

The plumage characters dealt with in the preceding section refer only to those typical of the mature individual of both sexes. The fact that the same differences are not exhibited by the young chicks prompts the question as to how far the hypothesis advanced previously can be applied towards an understanding of this difference in plumage characterisation.

*Description of the Plumage in the Chick.*—In both sexes the first definitive plumage of the young chick exhibits a marked similarity to

that of the adult female in regionalisation, structure, and colour of the feathers. The last, however, differs from that of the mature hen in that, although the female pattern is basically exhibited, it is less regular, the black pencillings being broader owing to a more extensive deposition of melanin. This increase in melanin may be particularly well shown in the breast feathers, where, instead of the pure salmon of the adult there is a definite mixture of black and red.

In the female chick this first plumage (with a few exceptions to be referred to specifically later) is gradually replaced by the type normally displayed by the adult, the change merely consisting of a restriction of the amount of melanin present and consequently leading to the expression of a more definite pencilling in the patterned feathers.

In the male, however, a type of plumage intermediate between that of the chick and the adult male appears. This is referred to as the juvenile plumage. It is characterised, with the exclusion of the breast feathers, by the gradual appearance of red pigment and of fringing in the distal region of the feather. At the same time, the female type of pattern is also obliterated in the proximal portion by a heavy deposition of melanin. On the wing this is heavier than in the adult. In the breast the black pigmentation extends rapidly at the expense of the red. Following this, the increase of fringing in particular regions and the sharp demarcation of red and black pigment give rise to the typical plumage of the adult male.

To return to a consideration of the first definitive chick plumage, at first sight it appears impossible to bring it into line with the argument previously developed—that the presence of female reproductive tissue is necessary for the development of the female pattern—since while the appearance of the latter characteristic in the female chick could be explained on this basis, its exhibition by the male is obviously not in agreement with our hypothesis.

A clue to the solution of the problem of the similarity of the chick plumage in the two sexes is obtained from the results of an experiment by Kopec and Greenwood, in which egg yolks were injected into the body-cavity of an ovariectomised Brown Leghorn. The poult in question had been ovariectomised 10 days after hatching. At the time of the experiment it was 16 months old, had never shown any comb growth, and was in typical male plumage. Thirty-eight days after a course of injections of egg yolk new feathers of a distinctly female appearance began to show, and continued to appear for 33 weeks. During the course of the experiment the amount of femaleness in the feathers

increased to a maximum and then gradually decreased again until all trace of it was lost. There was no clear-cut initial or end point to the effect.

Thus it appears that the ability of the ovary to induce specific characteristics in the plumage is also inherent to some extent in a product of the ovary—the egg yolk.

This ability of the yolk to produce a female type of feathering is of importance in considering the plumage of young chicks, since in all chicks at hatching unabsorbed egg yolk is present. We therefore incline to the view that the similarity of the plumage in chicks of both sexes to that of the female is to be explained by the presence of unabsorbed yolk. As development proceeds the effect expected from a gradual absorption of the yolk is seen in the plumage of the male, but is necessarily masked in that of the female by the onset and increase of the activity of the ovary.

We have yet to consider the apparent condition of hyperthyroidism in the chick as compared with the adult female. This might be due to a variety of circumstances, but since melanism occurs in the breast feathers of the chick this is most probably accounted for by supposing that the yolk has a less powerful restricting effect on the deposition of black pigment than has the female reproductive organ. The level of thyroid activity is obviously higher than that of the adult male, but whether it is also higher than that of the female cannot be determined. The question of its dependence on any particular agency is best discussed after a consideration of the state of thyroid activity in the juvenile fowl.

The fact that the amount of melanin present in certain areas of the juvenile male is somewhat greater than is typical of the adult, suggests that the thyroid is more active in the former state. That a higher level of thyroid functioning is also inherently characteristic of the young female is shown by the experiments of Pézard, Sand, and Caridroit. Ovariectomy performed post-pubertally was followed by the development of a type of plumage similar to that of the adult male. If, however, the operation were performed prepubertally, the plumage resulting was typical of the juvenile male. These results are in agreement with the observations on the level of thyroid functioning in immature individuals in other forms (Schafer).

From the sequence in plumage from juvenile to adult in the male it would seem that the higher level of thyroid function characteristic of the chick steadily decreases until that typical of the mature individual is reached; after the disappearance of the female pattern from the feathers

there is a gradual increase in the amount of red pigment and a coincident decrease in the amount of black. This progressive change in the proportions of the two colours, together with the increasing tendency to fringing in certain areas, is in line with the hypothesis of a gradual decrease in thyroid function. But whether this decrease is directly correlated with the disappearance of the yolk (which conceivably could have taken a part in the regulation of the thyroid function both during its embryonic development and after hatching) or whether it is a natural sequence in the development of the thyroid, unrelated to a sex stimulus, cannot be determined at the present stage of the investigation.

We have now to consider (1) some observational studies on control female chicks which tend to show that the development and maintenance of the female pattern is dependent upon two separate stimuli, acting consecutively, but which as a rule overlap sufficiently to give an apparently continuous effect, and (2) the results of some experiments which give an indication of the duration of the primary stimulus.

(1) *Control Birds*.—From a close examination of the development of the plumage in 100 control females it was found that while the majority of these birds passed directly from the chick to the normal adult feathering, some few showed interesting deviations. In the cape and shoulder, feathers with reddish areas appeared; on the wing, a similar tendency to the development of red pigment was seen, especially in the secondaries which were coming through at this time. In some cases it was possible to obtain, in the wing of one individual, a series of secondaries which passed from normal female pattern and colour through intermediate stages to a feather completely lacking in female pattern and similar to a male secondary. The female pattern gradually appeared again in each succeeding secondary. In the breast feathers, black pigment, instead of disappearing, actually became more intense, resulting in the formation of wholly black or black-splashed salmon feathers.

It should be noted that other individuals showed modifications in this direction but to a much less extent. Such modifications in the feathers are interpreted as an attempt to reproduce the type of plumage present in the juvenile male, and we suppose, further, that this tendency is due to the somewhat belated appearance of the second stimulus—namely the action of the reproductive organ.

(2) *Experimental Birds*.—Our experiments which bear upon the general problem concern the effect on the plumage of successful implantation of testis in the complete female chick. In all, 19 chicks were operated upon at various ages. The experimental method employed was

the implantation of testis material, from a brother of the same age, under the anterior lobe of the kidney on both sides of the body. In addition, a small piece of testis was implanted subcutaneously under the wing, to serve as some indication of the probability of successful implantation and growth of the larger pieces implanted in the body-cavity. Such a precaution is of value only in the early stages of the experiment, since, if the testis grafts flourish, they ultimately produce a marked effect on the development of the comb, which becomes greatly enlarged, thick, and upright, as in the male (Pl. IV, fig. 25). Details of the operation are shown in Table VI. Arbitrary grades in the degree of transformation of the plumage are given by the plus and minus signs. The various grades of transformation have been classified from a maximum (+ + +) down to slight modification (+), and finally no effect on the plumage (-).

TABLE VI.

Number of Bird.	Date of Hatching.	Age of Operation, in Days.	Degree of Plumage Transformation.
362	14.3.28	13	+ + +
735	9.5.28	13	+ + +
682	6.5.28	15	+ + +
970	29.5.28	17	+ + +
445	8.7.28	37	+ + +
42	26.7.28	19	+ +
458	8.7.28	17	+ +
982	7.8.28	21	+ +
904	24.5.28	22	+ +
943	29.5.28	20	+
151	8.6.28	25	+
286	16.6.28	20	-
169	6.8.28	10	-
70	27.7.28	19	-
887	24.5.28	23	-
113	8.6.28	25	-
618	27.4.28	39	-
672	6.5.28	30	-
462	8.7.28	37	-

It will be seen that of the 19 operated birds 11 showed some plumage change, while in the remaining 8 no deviation from the typical sequence of plumage changes in the young chick was noted; the latter show as yet no marked enlargement of the comb suggestive of maleness due to the influence of functioning male reproductive tissue, although in 5 of the 8 birds traces of the subcutaneous testis grafts are still to be seen. These birds are then to be considered for the present as unsuccessful attempts at testicular implantation, although only an examination of the

birds post-mortem can reveal whether they are to be regarded as completely unsuccessful.

With the other birds in the series typical changes in the plumage occurred, which may be attributed to the effect of the implanted testis. The fact that the extent of the change is related in some way to the age of the chick at the time of operation is suggested by an examination of the table, if we except for the present No. 445, an explanation of whose atypical behaviour will be attempted later. It is seen that the maximum effect is exhibited when the operation is performed at the end of the second week and the beginning of the third, the effect gradually decreasing in degree until the beginning of the fourth week. It will be necessary to perform a further series of experiments to determine whether this is the point in age of the chick beyond which no modification in the feathers can be produced.

*Plumage Changes.*—To avoid unnecessary repetition, birds showing approximately the same degree of modification will be considered together. In Nos. 362, 735, 682, 970 the effect of the operation was shown in the breast by a range of variation from completely black feathers in the case of the first two birds to a mixture of black, and black and salmon in the remaining two (Pl. IV, figs. 30, 31). Succeeding feather generations were typically female in the latter, but passed through intermediate grades before returning to normal in the case of the former two. In all the birds a definite fringing and a tendency to the formation of pointed feathers was induced in the saddle (Pl. IV, fig. 29). This reaches its maximum expression in the first two birds, where feathers similar in structure and colour to the male cape feathers appeared. In these feathers, however, the female pattern was not always completely obliterated. After this phase the new feathers growing in were typically female. The cape feathers (Pl. IV, fig. 27) did not show such extreme modifications in that, although slight fringing, varying amounts of red pigment and intensification of melanin were shown, the female pattern was invariably present in the apical region of the feather. Modification of the wing feathers was chiefly concerned with colour changes. In the secondaries, those appearing while the effect was being shown in the contour feathers had a bright red lower edge. Corresponding covert feathers came in solid black, while wing-bow feathers exhibited varying amounts of black and red splashing.

In Nos. 42, 458, 904, and 982 the effect was shown but to a much less marked degree than in the birds described above. Only an occasional pure black breast feather occurred, but the amount of black splashing

was much greater than that usually exhibited in the feathers of a young female. Slight modifications were also observed in the cape, saddle, and wing feathers.

In Nos. 943 and 151 the only effect shown was an abnormal amount of black splashing on the breast, other feather regions remaining typically female.

No. 445 has not been included with the first group of birds because, although modifications in the feathers similar in extent appeared, these have not been followed by a return to the female type up to the present time. The new feathers growing in still show the same degree of maleness.

*Discussion.*—What, then, is the explanation of these plumage changes brought about by the implantation of testis in the young female? They are not the same as those produced by thyroidectomy, since in this case the structural changes are unaccompanied by any marked decrease in the amount of melanin. Rather they appear to be more akin to those which accompany pre-pubertal ovariectomy, and we are thus led to the conclusion that they are modifications towards a juvenile male type of plumage.

In the theory put forward previously, the development of the plumage in the young female was attributed to the action of two separate but consecutively produced stimuli, the first, the yolk unabsorbed by the chick at hatching, and the second, the chick gonad, the diminishing action of the former being counteracted by the gradually increasing stimulus of the latter. From the recorded observations on the plumage of control females it would seem that the production of the gonadic stimulus up to the threshold value necessary to produce an effect on the plumage, probably does not overlap, to any great extent, the effective but decreasing stimulus of the yolk.

From this it would appear that a possible explanation of the plumage changes exhibited by these females with implanted testis could be found if it were postulated that the action of the testis was in some way antagonistic to the development of the gonad function, such antagonism leading to a temporary depression of this function and consequent delay in reaching the threshold value necessary for the exhibition of an effect in the plumage. The possibility that the action of the testis was to suppress the influence of the yolk has not been considered, since it seems likely that by thirteen days after hatching (the age at which the earliest successful implant was made) the influence of the yolk was becoming unimportant. It will be realised that exact interpretation of the results



is rendered difficult by the fact that a considerable period must elapse between the time at which the stimulus is applied to the feather germ, and the stage of development of the feather at which modifications can be seen.

On the hypothesis developed, the case of the prolonged exhibition of modified feathering by No. 445 might be explicable if we can attribute to the ovary of this bird a reduced function, independently produced by other agencies, and tending to limit the production of the stimulus to an amount close to the threshold value, so that the additive, depressive effect of the testis is sufficient to prevent the exhibition of an effective stimulus. This bird is considerably late in maturing, and is not in any way comparable with control birds of the same age, so that retardation in growth and function of the bird as a whole may be taken as a correlative indication of probable retarded ovarian function. With the exception of this bird, the extent of inhibition by the testis appears to be in direct relation to the stage in the development of the gonad.

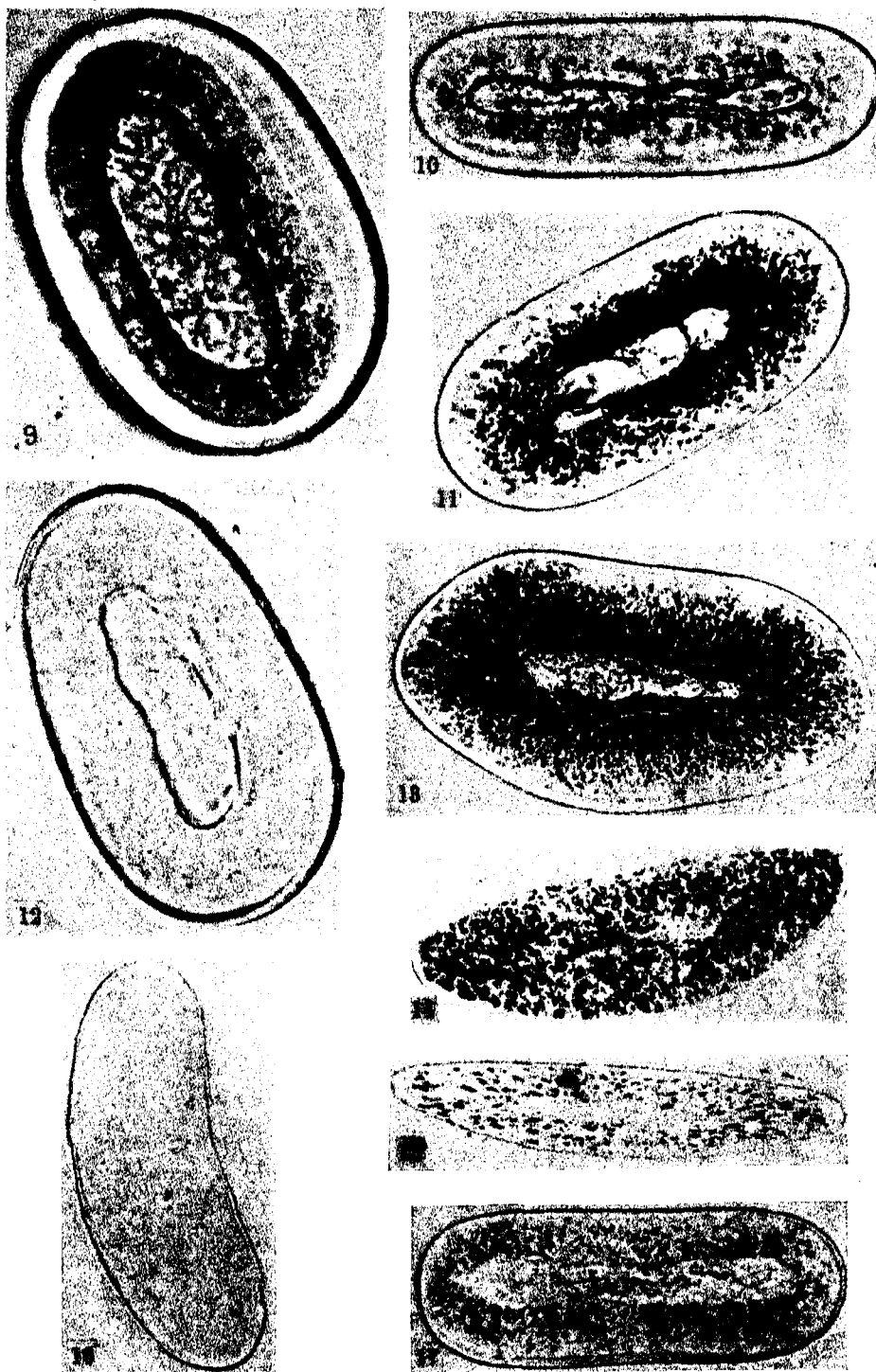
It is to be emphasised that the discussion and hypotheses developed in the preceding pages refer to the Brown Leghorn breed of the fowl and to this breed only. We are not in a position to discuss, without further research in the subject, their applicability to other breeds, sexually dimorphic in plumage, or to the more extreme types of feathering found in the Silky and Hen-feathered breeds. That the thyroid gland does enter into the question in the last two classes has been shown by Crew in the case of the latter, and by a preliminary experiment in thyroid feeding which we carried out in the former. But to what extent the thyroid gland is responsible for the maintenance of these plumage types, and how far the feathering is dependent on genetic and other factors, has yet to be shown.

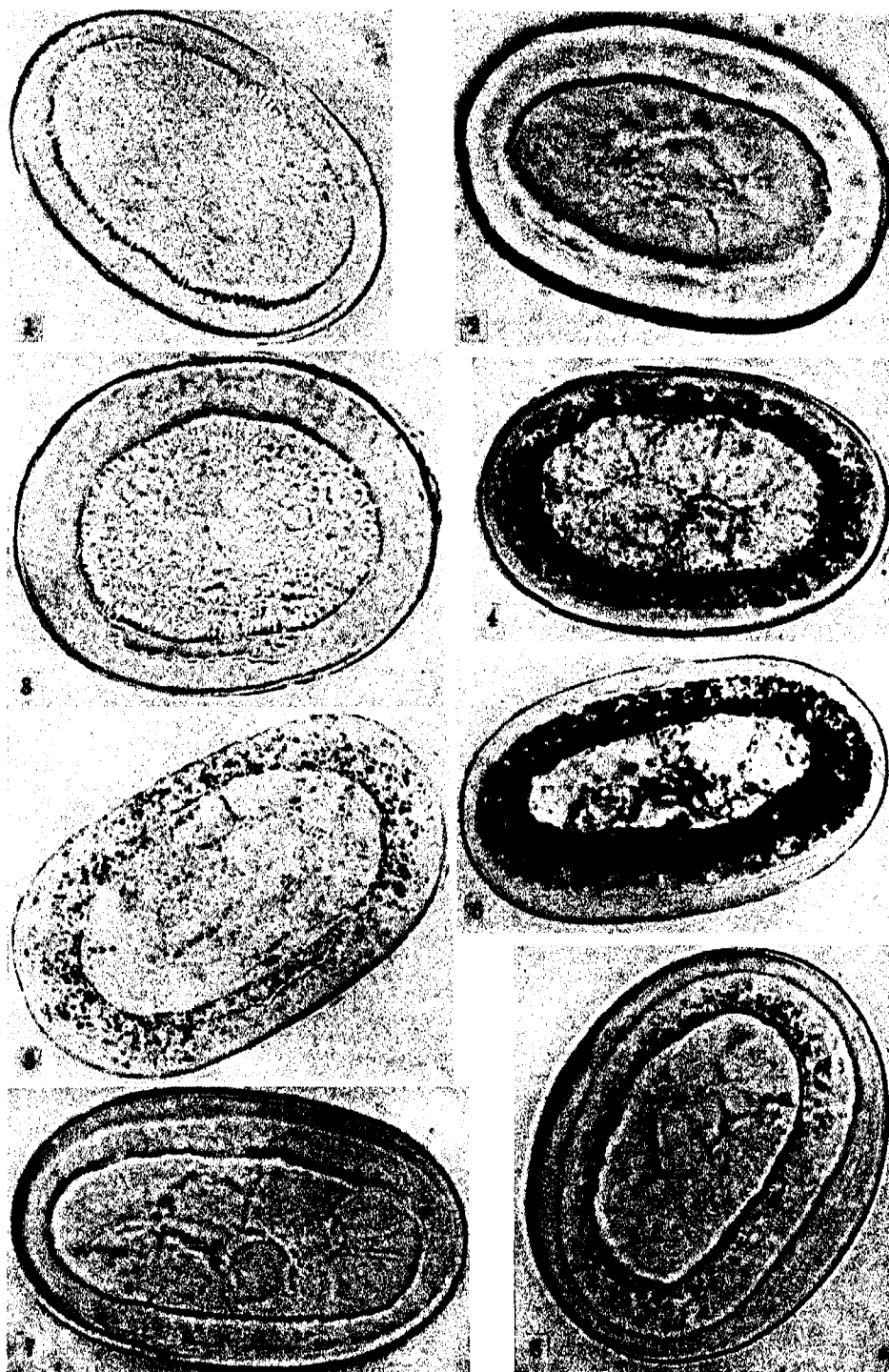
#### GENERAL SUMMARY.

1. The plumage of the Brown Leghorn fowl is analysed and the extent of its dependence on the activity of the thyroid and gonad is discussed.

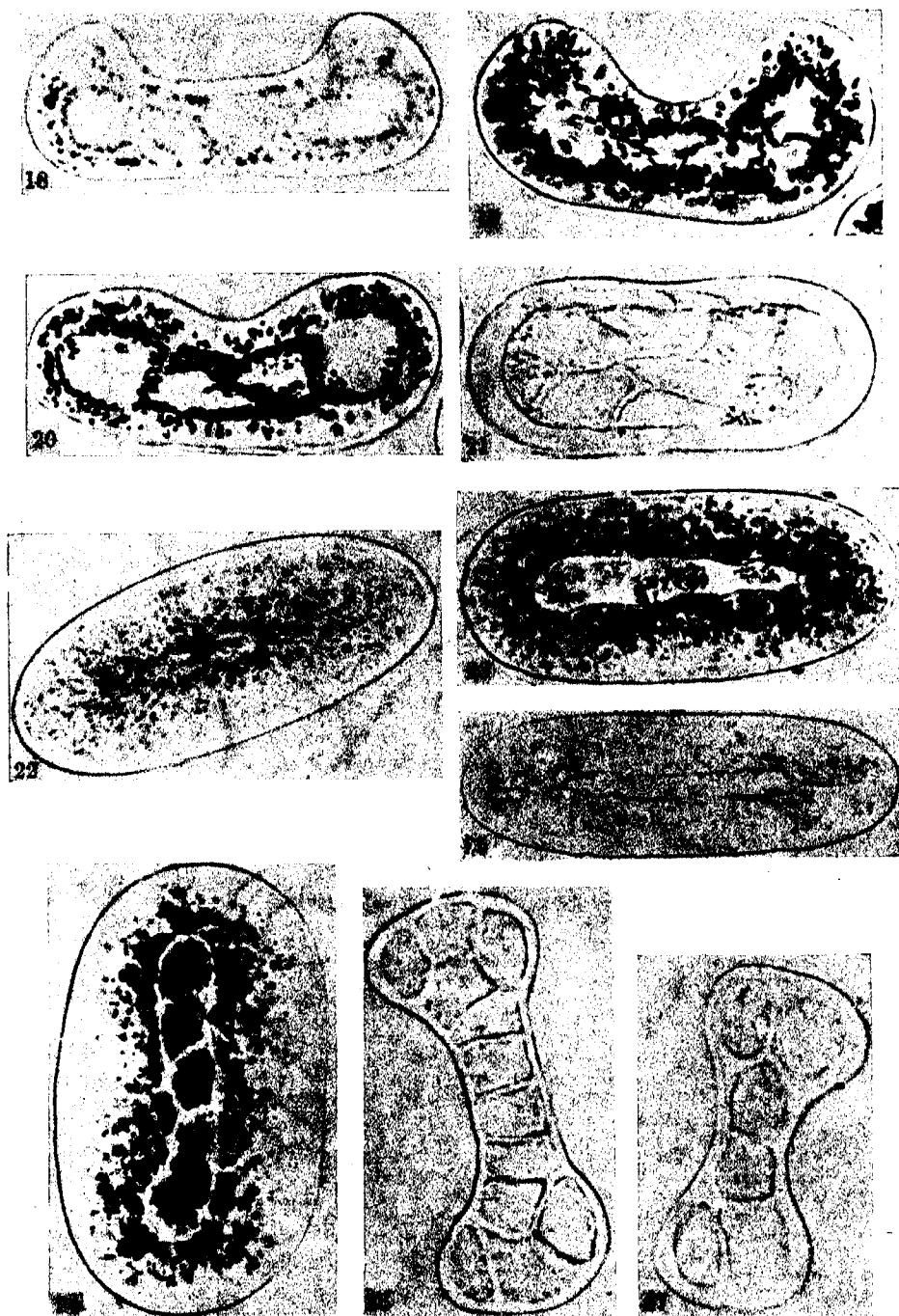
2. Hypothyroidism results (a) in a diminution in the amount of melanin and a coincident increase in the red pigment; (b) in an increase in the amount of fringing due to a lack of barbule formation. The female pattern tends to disappear.

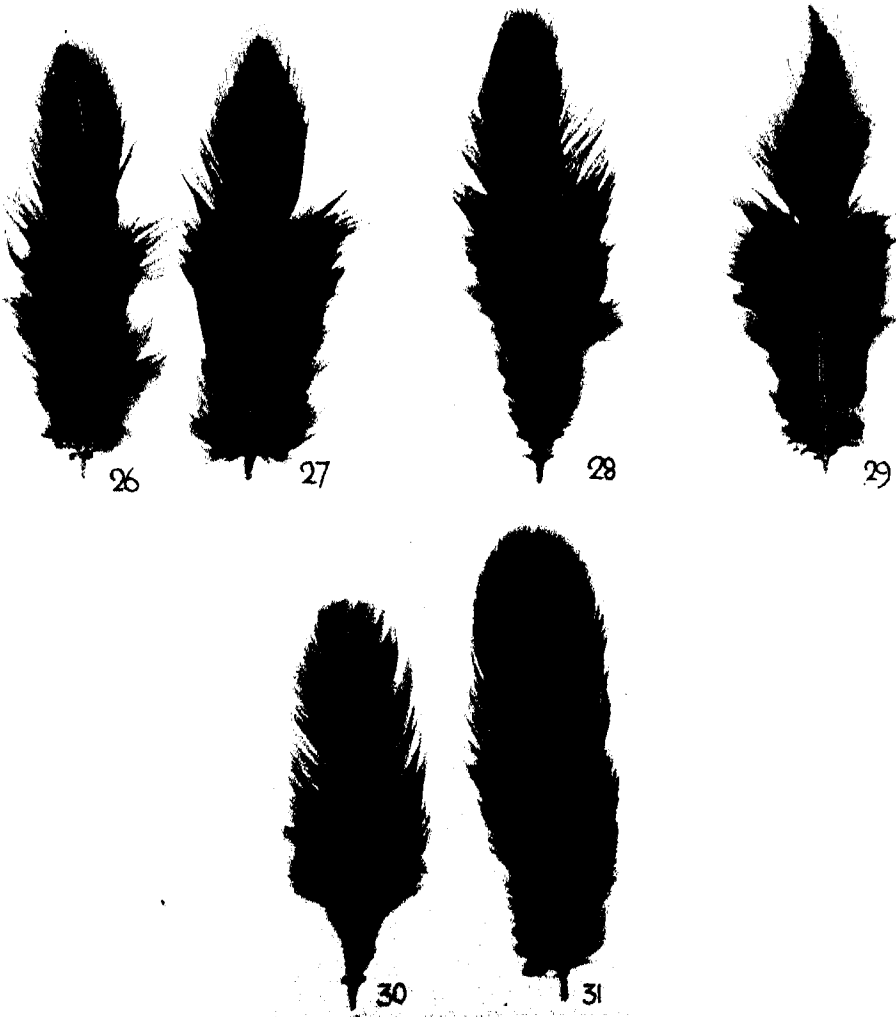
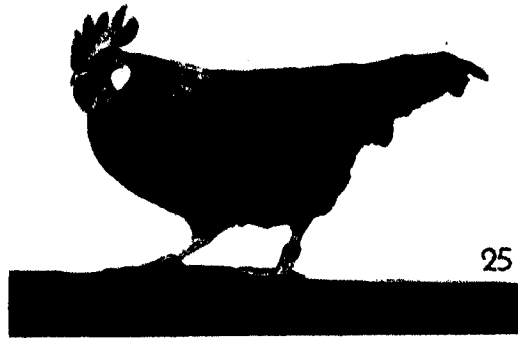
3. Hyperthyroidism in the male gives exactly the opposite effect—i.e. the melanin increases in amount while the red pigment and fringing tend to disappear. In the female the effect of hyperthyroidism is slight, and with moderate doses of thyroid there is practically no modification













of the female pattern of pencilling and no melanin appears in the breast. The neck hackle, however, becomes darker and shows a decrease in fringing.

4. From these results, together with what is known concerning the effect of gonad on plumage, a hypothesis is advanced, that whereas the plumage typical of the male is developed independently of the gonad and depends for its maintenance on a certain level of thyroid functioning, both gonad and thyroid play a part in regard to that of the female: the former stimulates the latter to a higher level of activity than that present in the male and so indirectly causes a hyperthyroid effect on the feathers. At the same time it modifies this condition by acting directly on the feathers and restricting the deposition of melanin.

5. The fact that in both sexes the plumage in the young chick is similar to that of the female puts this theory in question. There is evidence to show, however, that yolk may have a modifying effect on plumage similar to that of the ovary, and thus the doubt regarding the validity of the hypothesis can be removed by the suggestion that the chick plumage develops under the influence of the yolk in its own yolk sac. This second theory gains confirmation by a study of the atypical plumage which is occasionally met with in growing females, and also by a consideration of the type of plumage developed in juvenile females following the successful implantation of testis.

#### REFERENCES.

1. COLE, L. J., and REID, D. H. (1924). "The Effect of Feeding Thyroid on the Plumage of the Fowl," *Jour. Agric. Res.*, vol. xxix, No. 6, pp. 285-287.
2. COOPER, E. R. A. (1925). "The Histology of the more Important Human Endocrine Organs at Various Ages," *Oxford Medical Publication*.
3. CREW, F. A. E. (1927). "Die Wirkungen der Schilddrüsenektomie am hennengefederten Hahn," *Arch. f. Gefl.*, vol. i, No. 7, pp. 234-239.
4. DOMM, L. V. (1927). "New Experiments on Ovariectomy and the Problem of Sex Inversion in the Fowl," *Jour. Exp. Zool.*, vol. xlviii, No. i, pp. 31-171.
5. GREENWOOD, A. W. (1928). "Studies on the Relation of Gonadic Structure to Plumage Characterisation in the Domestic Fowl.—IV. Gonad Cross-Transplantation in Leghorn and Campine," *Proc. Roy. Soc., B*, vol. ciii, pp. 73-81.
6. HORNING, B., and TORREY, H. B. (1927). "Thyroid and Gonad as Factors in the Production of Plumage Melanin in the Domestic Fowl," *Biol. Bull.*, vol. liii, No. 4, pp. 221-232.
7. KOPEC, S., and GREENWOOD, A. W. (1929). "The Effect of Yolk Injections on Plumage in the Ovariectomised Fowl," *Roux' Arch. f. Entw. mech.* (in the press).



8. KŘÍŽENECKÝ, J., and NEVALONNYJ, M. (1927). "Weitere Versuche über den Einfluss der Schilddrüse und der Thymus auf die Entwicklung des Gefieders bei den Hühnenküken," *Roux' Arch. f. Entw. mech.*, vol. cxii, pp. 594-639.
9. KUHN, O. (1927). "Die Differenzierung des Haushuhngefieders durch Schilddrüse und Gonaden," *Zuchtungskunde*, vol. iii, No. 2, p. 62.
10. LATIMER, H. B. (1924). "Post-natal Growth of the Body Systems and Organs of the Single Comb White Leghorn Chicken," *Jour. Agric. Res.*, vol. xxix, pp. 363-397.
11. PEZARD, SAND, and CARIDROIT (1925). "L'évolution des Potentialités chez la Poulette," *C.R. Soc. de Biol.*, vol. xcii, pp. 495-496.
12. RIDGWAY, R. (1886). *A Nomenclature of Colors for Naturalists*, Little, Brown & Company, Boston.
13. ROXAS, H. A. (1926). "Gonad Cross-Transplantation in Sebright and Leghorn Fowls," *Jour. Exp. Zool.*, vol. xlvi, No. 1, pp. 63-113.
14. SCHAFER, E. SHARPEY (1924). *The Endocrine Organs*, 2nd edit., Longmans, Green & Company, London.
15. UHLENHUTH and KARNS (1927). *Anat. Rec.*, vol. xxxv, No. 1 Abs., p. 27.
16. WILSON, G. E. (1927). "The Thyroid Follicle in Man, its Normal and Pathological Configuration," *Anat. Rec.*, vol. xxxvii, pp. 31-61.
17. ZAWADOVSKY, B. M. (1927). "Zur Frage der Wechselbeziehungen zwischen Schilddrüse und Geschlechtsdrüsen bei Hühnern," *Roux' Arch. f. Entw. mech.*, vol. cx, No. 1, pp. 149-182.
18. ZAWADOVSKY, B. M., and ROCHLIN, M. (1928). "Zur Frage nach dem Einfluss der Hyperthyreoidisierung auf die Färbung und Geschlechtsstruktur des Hühnergefieders," *Roux' Arch. f. Entw. mech.*, vol. cxiii, No. 2, pp. 323-345.

#### LIST OF ILLUSTRATIONS.

##### PLATE I.—HISTOLOGY OF REGENERATED THYROIDS.

- Fig. 1. Right regenerated thyroid from No. 35, showing extreme cyst formation. ( $\times 85$ .)
- Fig. 2. Portion of cyst wall at (A) to show the epithelial lining. ( $\times 800$ .)
- Fig. 3. Left regenerated thyroid of No. 99, showing tendency to cyst formation by fusion of vesicles. ( $\times 35$ .)
- Fig. 4. Right regenerated thyroid from No. 57; the small vesicles are arranged at the periphery of the gland. ( $\times 25$ .)

##### PLATE II.—HYPOTHYROIDISM.

##### A. Cape feathers (slightly enlarged) from :—

- Fig. 5. Normal female.
- Figs. 6 and 7. No. 34 ♀, showing fringing of the feathers and obliteration of the female pattern by red pigment. The tip of both feathers had been developed before the effect of the operation was felt.
- Fig. 8. No. 76 ♀, showing the effect of complete athyroidism in the lower half of the feather.

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### *B. Wing-bow feathers (slightly enlarged) from :—*

Fig. 9. Normal female.

Fig. 10. No. 86 ♀ (thyroidectomised).

Fig. 11. No. 115 ♀ (        „        ).

Fig. 12. No. 76 ♀ (completely thyroidectomised).

### *C. Breast feathers ( $1\frac{1}{2}$ times natural size) from :—*

Fig. 13. Normal female.

Fig. 14. No. 34 ♀. Note structure similar to male cape feather.

Fig. 15. No. 76 ♀.

## PLATE III.—HYPERTHYROIDISM.

### *A. Neck hackle feathers from No. 475 ♀ (about natural size).*

Fig. 16. After thyroid feeding.

Fig. 17. Before thyroid feeding.

### *B. Saddle feathers from No. 474 ♂ (about $\frac{3}{4}$ natural size).*

Fig. 18. Before the experiment.

Fig. 19. During period of thyroid administration.

Fig. 20. After thyroid feeding had ceased, note transition from hyperthyroidic effect back to normal in lower part of feather.

### *C. Breast feather from No. 475 ♀. (Natural size.)*

Fig. 21. Showing the increase in red pigment proximally due to the cessation of thyroid feeding.

### *D. Breast feathers from 169 ♂.*

Fig. 22. Showing persistent red portion medially due to hypothyroidism. (Natural size.)

Fig. 23. Completely black feather which grew in following thyroid feeding. (Natural size.)

Fig. 24. Particoloured feather which appeared after the cessation of thyroid feeding. (Natural size.)

## PLATE IV.—FEMALES WITH TESTIS GRAFTS.

Fig. 25. No. 362 ♀ exhibiting in its plumage a mixture of female and juvenile male feathers.

### *A. Cape feathers of No. 735 ♀. (Slightly reduced.)*

Fig. 26. Female.

Fig. 27. Tending towards juvenile male.

### *B. Saddle feathers of No. 735 ♀. (Slightly reduced.)*

Fig. 28. Female.

Fig. 29. Modified feather imitating male cape in colour and structure.

### *C. Breast feathers of No. 735 ♀. (Slightly reduced.)*

Fig. 30. Young female.

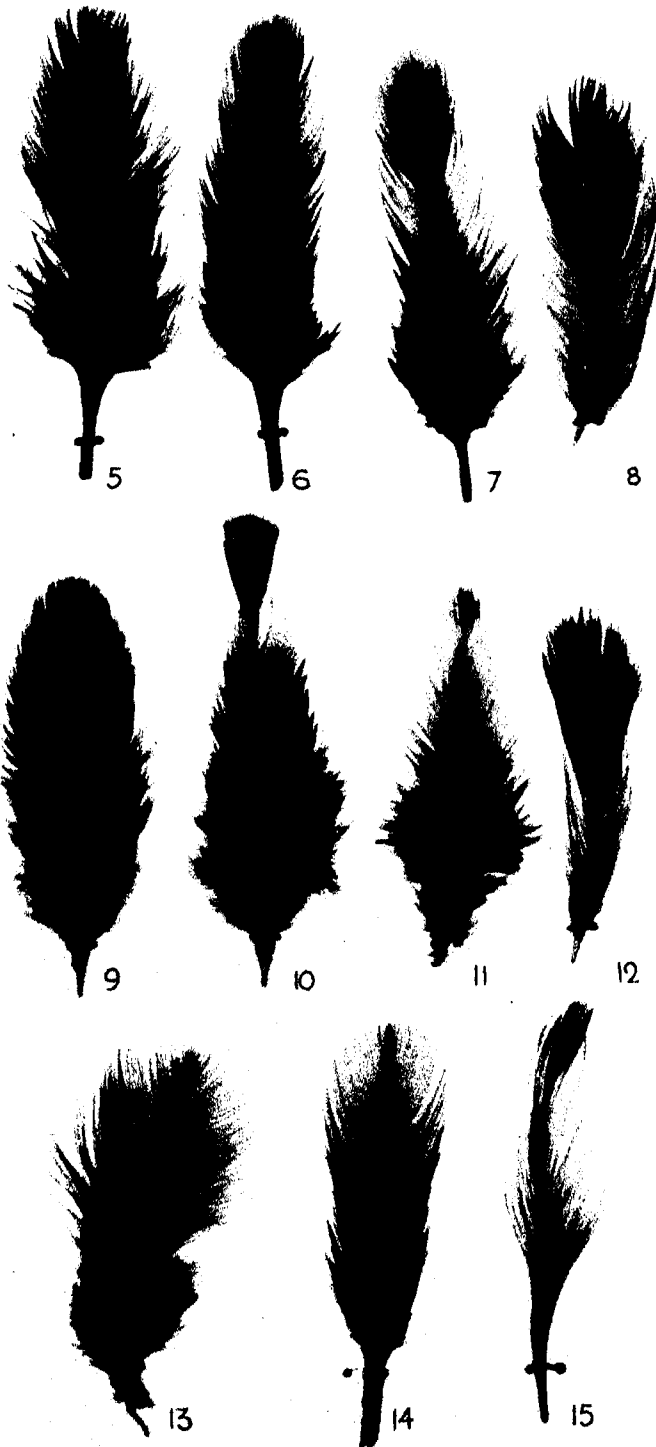
Fig. 31. Juvenile male.

(Issued separately September 4, 1929.)

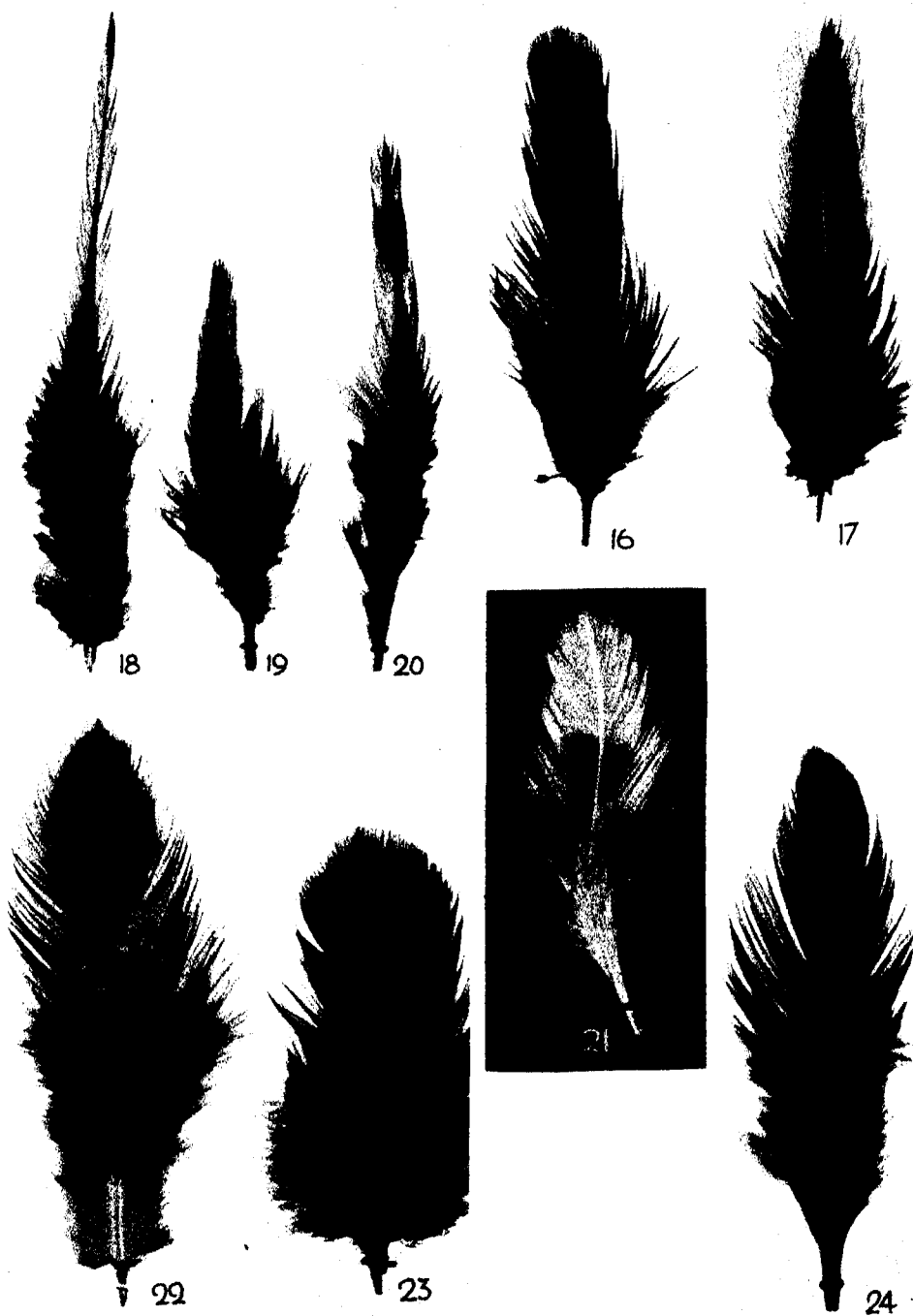
















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